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USA: ECONOMICS, POLITICS, IDEOLOGY

No 2, February 1988

Technological Basis for Space Militarization

18030006a Moscow SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA in Russian No 2, Feb 88 (signed to press 21 Jan 88) pp 13-22

[Article by Aleksey Pavlovich Kireyev, candidate of economic sciences and instructor at Moscow State Institute of International Relations: "The Militarization of Space and Technological Imperialism"]

[Text] The years since the Reagan Administration's announcement of the "Strategic Defense Initiative" (SDI) have proved that this was not simply a matter of military-strategic objectives. The SDI is also a form of "technological imperialism" aimed against rivals in competition- -i.e., against the United States' closest allies. Conceived as a means of attaining military superiority, the "Star Wars" program is also supposed to aid in solving another problem: in raising American R & D to a level of development which will allow the United States to leave its closest competitors far behind and widen the gap in the sphere of military technology while simultaneously making economic advances, acquiring stronger control over allies, and keeping other "power centers" from issuing any serious technological challenges to the United States.

Technological Basis for Aggression in Space

After the United States experienced the serious weakening of its competitive position in the sphere of advanced technology in the 1970s, it resolutely regrouped its forces in this decade, striving to concentrate them in the leading areas of scientific and technical progress.

The catalyst of this process was militarism, which has traditionally served as a means of stimulating the economy. When it was lifted into outer space by the Reagan Administration, it was supposed to augment the capacity of the government-guaranteed market, stimulate the use of technological innovations primarily for military purposes, and raise the profit margin of defense production even higher. The "Star Wars" program has economic goals as well as military and political ones.

First of all, it is supposed to integrate all earlier research connected with missile and air defense in a single massive program and thereby focus efforts on the financing of projects capable of producing practical results in the near future. "The work on many projects now being financed by the SDI Organization (SDIO) began many years ago," the NEW SCIENTIST reported. "Laser weapons, rail guns, and chemical- propelled missiles are just a few examples."[1]

Its second goal is the guarantee of the continued growth of allocations for the military use of space, including all previous investments in this sphere, as a result of the augmentation of military programs. Ever since the beginning of the space age the United States has made the space component an organic part of its military-technical projects. Furthermore, approximately one-third of the 150 billion dollars invested in space activity since that time has been used for military purposes.[2]

The third goal is the guaranteed issuance of costly contracts to the American military industry and research organizations for the next 25 or 30 years.

Finally, the United States wants to arrange for transnational military- industrial cooperation with its closest allies for the purpose of usurping the technical ideas and industrial innovations that have been developed in other countries but might also be used in the creation of space weapons systems.

The Pentagon is relying most heavily on industrial corporations in the financing of scientific and technical programs for the SDI, but it is also encouraging universities to work on these programs. The total R & D expenditures of universities and colleges are only equivalent to one- eighth or one-tenth of the expenditures of American private business. The government, however, is actively supporting military research in universities and the scientific laboratories working under their auspices. In the last decade the percentage of these projects in all R & D was approximately twice as high in universities as in private companies.[3]

In 1985 Defense Department investments in university research reached 930 million dollars, displaying an increase of almost 90 percent since the beginning of the 1980s. Research financed by the military establishment now accounts for 16 percent of all university R & D, as compared to 10 percent in 1980.[4] Besides this, the key areas of university R & D are quite heavily dependent on government funding. The government finances 82 percent of all projects in astronautical engineering, 56 percent in electrical engineering, 48 percent in materials engineering, and 46 percent in computer science.[5]

As a result of the reordering of government financing priorities at the end of the 1970s, the percentage of military R & D in total federal expenditures on science rose sharply. Whereas it stayed between 48 and 56 percent in 1965-1980, it leaped to 67 percent in 1985 and reached 72 percent in 1986.

According to the data of the Federation of American Scientists, 75 percent (in terms of cost) of the contracts awarded as part of the "Star Wars" program in 1983-1986 were awarded to only 20 corporations and scientific centers (Table 1). Aerospace corporations received the overwhelming majority of contracts. For example, Lockheed is working on antisatellite weapon and laser targeting systems, space-based ICBM interceptors, and space surveillance systems; TRW is developing chemical lasers, free-electron lasers, a new generation of computers, and surveillance systems; Boeing is conducting research into optical tracking systems, lasers, electromagnetic railguns, and ABM software; McDonnell Douglas is developing terminal defense, space-based interceptors, laser accelerators, infrared sensors, etc.[6]

Table 1. Largest Scientific SDI Contractors in 1983-1986

Contractors	Cost of contracts, in millions of dollars
Lawrence-Livermore Laboratory	725
General Motors	579
Lockheed	521
TRW	354
McDonnell Douglas	350
Boeing	346
Los Alamos Laboratory	196
Rockwell International	188
Teledyne	180
AG & G	140
Gencorp	135
Textron	93
Sandia Laboratory	91
LTV	90
Flow General	89
Raytheon	72
Science Applications	69
Honeywell	69
Nichols Research	63
Lincoln Laboratory, MIT	63

Source: AVIATION WEEK AND SPACE TECHNOLOGY, 21 April 1986, p 75.

The main SDI contractors include four government-run nuclear research laboratories. The Livermore Lab was the first to begin researching space weapons back in the early 1970s. Now scientists there are investigating the possibility of the use of lasers in combat and are conducting experiments in nuclear synthesis and in directing the energy of charged particles. The Los Alamos and Sandia laboratories were the first to conduct complex research projects in particle beam weapons. The Lincoln Laboratory of the Massachusetts Institute of Technology is specializing in computer software.

The AG & G corporation, which operates the nuclear test site in Nevada, has taken a prominent place among the "Star Wars" contractors. The expenditures on the nuclear tests needed for the development of one component of the SDI—the x-ray laser pumped by the explosive power of a nuclear device—are also included indirectly in the total cost of the "space shield."

Therefore, Washington's doctrine of space militarization has intensified the tendency to use the results of advanced development projects for military purposes first and the continued militarization of the entire "science-technology-production" cycle, which Washington strategists expect to promote U.S. technological breakthroughs in the third millennium. "The Pentagon's technological challenge," France's L'EXPRESS remarked, "clearly indicates the real reason for the race to space. In the last century the world was ruled by the sea powers, but today supremacy in space is laying the basis for world supremacy in the next millennium."[7]

At the same time, even observers in the United States and Western Europe are admitting that the funds for SDI and corporate projects are undergoing frequent cuts and are not corresponding in general to previously announced figures.

Technological Partnership?

By actively drawing its closest allies into the "Star Wars" orbit, the United States hopes to solve an entire group of problems. Above all, Washington hopes to establish stricter control over the military- economic development of allies, especially in the development and production of equipment which could be used in the future to create ABM systems with space-based elements independently of the United States.

The American military-industrial complex also wants to obtain access to certain types of new technology used for military purposes in some NATO countries, Japan, and Israel. Data on participation in the work on the SDI by the imperialist countries which signed the corresponding intergovernmental documents are presented in Table 2.

Table 2. Participation by U.S. Allies in SDI

Country	Official documents	Areas of technological interest to United States	Development companies
Japan	Cabinet of Ministers decision of 9 September 1986; agreement with United States on participation by Japanese firms in work on SDI of 21 July 1987	High-energy lasers, optical data storage systems, supercomputers, mercury-cadmium-tellurium alloys, liquid crystal displays, chips for graphics, fiberglass systems of local computer communications, electroluminescent displays, laser tubes	Matsushita Fujitsu, Hitachi, Nippon Electric, Nippon Telegraph & Telephone, Nikon, Mitsubishi, Sony, Sumitomo Denki, Nissan, TDK
FRG	Joint agreement on principles between governments of FRG and United States; agreement on participation by West German firms, research establishments, and other organizations in SDI research, signed 27 March 1986	Laser and electromagnetic railgun stabilization and targeting systems, detection and tracking systems, free-electron lasers, chemical lasers for short-range ABM systems	Messerschmitt-Belkov-Bloehm, Siemens, Dornier, Dynamit Nobel, Rheinmetall, Karl Diehl, Daimler-Benz
Great Britain	Memorandum on mutual understanding, signed with United States 6 December 1985	Particle beam weapons, optical computers, computer programming technology, electromagnetic launchers, space platform power plants, battle management equipment (18 areas in all)	British Aerospace, Pilkington, Dunlop, Rolls Royce, General Electric, Marconi, Plessey, Software Science, Logica
Italy	Memorandum on mutual understanding, signed with United States 19 September 1986	New composition materials, technology for military use of infrared beams and lasers, thermography, fifth- generation computers	Agusta, Aermacchi, Aeritalia, Selenia, Elettronica, Galileo, Fiat, Montedison, Finmeccanica, OTO Melara
Israel	Memorandum on mutual understanding, signed with United States 6 May 1986	Electromagnetic railguns, compact laser devices, space-based sensors, kinetic weapons, short-range missile interception systems	Israel Aircraft, ELOP, Tadiran, Sorek, Israel Military Industries, Technion, Raphael

Sources: AVIATION WEEK AND SPACE TECHNOLOGY, MILITARY SPACE, AEROSPACE DAILY, and DEFENSE SCIENCE for 1984-1987.

The United States is particularly interested in persuading prominent people in the natural sciences to work on the development of space weapons. The head of the SDIO, J. Abrahamson, made the following statement in this connection: "We want to use the best technical minds to work on the American projects because we want to implement them as quickly and as inexpensively as possible."[8]

By including its allies in the work on the SDI, the United States is creating a new type of brain drain: It is not necessary for many foreign scientists to move to American research centers. They work in their own countries on contracts from the U.S. Government, which will own all of the results of their work. If any of America's partners should want to make use of the technology developed by its scientists, it will have to buy this right from Washington. A new system has been established for the legal regulation of military-industrial cooperation with foreign countries to authorize the recruitment of foreign partners to work on secret Pentagon programs. This was prohibited in the past. Within the SDI framework many subprograms are given enigmatic codenames ("Excalibur," "Super-Excalibur," "Cottage," and others) and large experiments are broken up into several small ones in which the participants have no complete knowledge of the technology or space weapon component being developed.

The United States has defined three possible levels of transnational military-industrial cooperation: governmental (or state), departmental, and production.

The state level of cooperation envisages the signing of intergovernmental documents (for example, the "memoranda on mutual understanding"), which attest to the country's approval of the American SDI program. On the basis of these documents, private and government organizations and firms can participate in this work. Furthermore, the state frequently pledges to give financial support and incentives to the firms deciding to bid on contracts for the development and production of space weapons systems. Virtually all of the bilateral documents specifically state that the allies of the United States will subsidize the "Star Wars" research conducted on their territory. In this way, Washington hopes to alleviate the problem of its high capital requirements.

The interdepartmental level of cooperation on the military-space plans envisages the development of direct contact between the SDIO on one side and foreign enterprises, firms, or scientific laboratories on the other. In the opinion of the Americans, this kind of contact is more productive because it eliminates many bureaucratic formalities and saves the time it takes for documents to make their way through numerous government agencies in the cooperating countries.

This allows the SDIO, the only American client ordering "Star Wars" technology, to choose partners directly from among the firms in other capitalist countries and establish long-term and stable scientific- production relations with them. Direct communication between developers and producers reduces the risk of information leaks and simplifies the integration of science with production.

Finally, the production level of transnational military-industrial cooperation envisages essentially subcontracting relations between American contractors and their overseas suppliers. The orders issued to foreign firms by American corporations stimulate the search for new technological designs while simultaneously restricting freedom of action, because the components manufactured by allies must eventually become part of more complex weapons systems assembled in the United States.

Plans are now being carried out in Western Europe for the creation of a "European Technological Community" in accordance with the "Eureka" program and the European version of the missile defense system, the "EurDI." The United States sees the participants in "Eureka" and the EurDI less as competitors than as potential collective "Star Wars" contractors.

In view of the fact that all five of the main areas of research in the "Eureka" program were present to some extent in the SDI program, the United States began to pressure its West European allies to orient "technological Europe" primarily toward military objectives. President F. Mitterand of France, who had put forth the idea of "Eureka" as an actual counterbalance to the SDI, said that it would be possible to "build bridges"[9] between the two programs, and the propaganda network began spreading the idea that "Eureka" is a civilian program of scientific and technical development with a "military undercurrent" while "Star Wars" is a military program with a "civilian undercurrent."

The American "Star Wars" program is more closely related to its European counterpart, the EurDI. "The operation known as the 'European Shield,'" remarked Italy's EUROPEO magazine, "will be an ideal channel for the massive and systematic flow of European ideas and projects in modern technology to the United States. It is the United States which will secure the right, for the ridiculous sum of 60-70 million dollars a year, to all of the best ideas and projects of almost 300 leading European enterprises, including two dozen Italian ones. In short, this will be unprofitable and degrading."[10]

International consortiums of American and West European firms are being formed to work on the "space shield," and U.S. corporations are playing the main role in them. A consortium formed in summer 1986, for example, unites almost 50 American and West European companies which were supposed to submit competitive bids at the beginning of 1987 on contracts for the "architecture" of missile defense in the European theater of military operations.[11] The Lockheed Missile and Space corporation heads a consortium of firms, including Dornier (FRG), General Research, Seacon, and Marconi (England), and Raytheon headed a consortium including CRS Technologies and Martin-Marietta (United States) and AEG Telefunken (FRG).

Therefore, transnational military-industrial cooperation between the United States and its closest allies in the development of "Star Wars" systems is displaying intensive growth. As part of this process, Washington is striving to make maximum use of West European programs, which undoubtedly have their own priorities, for the scientific and technical support of its own military-space plans.

Military-Space Plans and Scientific-Technical Progress

One of the most important problems being discussed in the Western political and business communities is the need for reliable assessments of the possible consequences of Washington's "Star Wars" program, including consequences related to scientific and technical progress.

The most important objective of the current phase of scientific and technical progress is the improvement of computers. It envisages the development of a new generation of computers capable of performing over 10 billion operations per second and utilizing elements of artificial intelligence, high-speed fiber optics communication systems, and a new generation of satellite communication systems capable of transmitting information over unlimited distances.

The work in virtually all of these fields is being coordinated with the SDI program, particularly the part of the program envisaging the creation of space battle management and analysis systems. These will require, according to the data of American experts, computers operating at many times the present maximum speed. As yet, no more than 3-5 percent of the SDI budget is being spent on work in this field.[12] Apparently, numerous projects in progress in the field of military electronics in the United States have permitted the allocation of relatively small sums to date. In terms of technical parameters, the developmental level of American military electronics is approximately 10 years ahead of the average level in the capitalist world.[13]

Some diagrams in U.S. NEWS AND WORLD REPORT indicated that the computers developed within the SDI framework have reached the stage of operational testing, and software is in the stage of laboratory research and is advancing quickly to the stage of operational testing.[14]

In this way, the "Star Wars" program is superimposed, as it were, on civilian R & D in the United States. This is why the development of fundamentally new equipment and technology in the future will be less a result of the work on the SDI than a result of the subordination of all projects to the SDI. The most typical example is the so-called "strategic computer initiative" (SCI), which is being implemented outside the SDI framework but essentially represents one of its key elements.[15]

Another priority field of scientific and technical progress is the development of new production automation equipment, automated project planning systems, robots and manipulators, easily convertible production systems, etc.

The SDI program does not envisage the development of production automation equipment directly. The creation of robots and automatic manipulators for use in space is being financed by NASA programs, primarily the Space Shuttle program.[16] Apparently, the United States is counting on widening the gap between it and its allies precisely in the sphere of automation, which is one of their top priorities. Furthermore, the SDI program itself does not secure an increase in funds for automation research but is usurping existing civilian projects in the most promising fields on the pretext of higher "security interests."

The next area of scientific and technical progress is the search for new sources of energy and the development of nuclear power engineering. The nuclear aspect of the SDI program is confined to the development of the x-ray laser. All other nuclear programs are outside this framework. According to the estimates of SUEDDEUTSCHE ZEITUNG, the development of the x-ray laser will take another 15 years or so and up to 10 percent of the SDI budget.[17] According to American scientists, the work on the x-ray laser is now concentrated on converting the energy of a nuclear explosion into an x-ray beam. In other words, it has virtually no connection with the improvement of methods of controlling the nuclear reaction itself. This, however, does not mean that the results will not affect the development of nuclear technology in the civilian sector, but it is true that these results will be negligible in comparison with military results.

As for the important field of materials engineering, allocations for this purpose are envisaged in the SDI in the process of the work on the laser and electromagnetic railguns, power supply systems, and some specific types of weapons. Materials engineering projects conducted as part of the "Star Wars" program include the development of the composition metal-polymers with the solidity and infusibility of ceramics and the pliability of metal; the development of super-strength polymer frames, new methods of influencing the molecular structure of the metallic surface, and substances with certain optical properties; membrane technology.

In this sphere of the work on the SDI, the United States is relying on its own and on West European and, especially, Japanese producers of new materials. For this reason, the creation of these materials is most likely to be the result of scientific and technical cooperation, which the United States will use for military-space purposes.

As far as other areas of scientific and technical progress are concerned (especially biotechnology and genetic engineering), the SDI program does not envisage projects in these fields, but its supporters are not excluding the possibility of obtaining new results for the attainment of military objectives in space in the future.

The usurpation of the latest scientific achievements by the military- industrial complex, which is longing for space weapons, will lead to more pronounced disparities in the technological development of the United States and will preclude the extensive and complete use of the possibilities offered by the current phase of scientific and technical progress. The SDI's apologists maintain that the creation of space battle systems will lead inevitably to discoveries signalling radical advances in productive forces.

There is no question that military R & D, especially in the stage of basic research, can provide new theoretical conclusions applicable to civilian needs, but many economic studies have confirmed that the "military approach" to the achievement of scientific and technical results of value to the civilian sector is much more costly than a peaceful approach. English researchers have calculated, for example, that this method of attaining civilian results in nuclear power engineering cost four or five times as much as nuclear research geared to civilian needs from the very beginning.[18]

The current phase of the arms race will shift the emphasis from basic to applied research, which is also predominant in the SDI program. No more than 3 percent of the "Star Wars" budget in fiscal year 1987 was spent on the basic research which the PHILADELPHIA INQUIRER calls "the main source of innovation and civilian benefit,"[19] while the rest was used to adapt existing technology for battle management in space.

The SDI projects most likely to produce "dual-purpose" technology are the sections of the program not related directly to the creation of a specific type of weapon. No more than 10-12 percent of the SDI budget, however, is to be spent on this kind of research.[20] For this reason, the commercial potential of the technical innovations created during the preparations for "Star Wars" will not exceed the potential of other military R & D projects, nine-tenths of which, according to numerous estimates, are useless in the non-military sector[21] and absorb resources removed forever from national economic circulation. There are other estimates, however, which demonstrate the great impact of this kind of "technology transmission."

Much of the equipment developed within the SDI framework is so specific that, as American experts admit, it is either absolutely inapplicable to civilian needs or requires serious modification. At a high cost, for example, space battle management systems could be adapted for highway or air traffic control or for flexible production units. Even if this equipment could be used in the non-military sector without any adaptation, however, in most cases it would not be competitive because of the high cost of specific quality requirements. And the adaptation of technology requires substantial expenditures.

Furthermore, a characteristic feature of contemporary scientific and technical progress in the capitalist world is not the conversion of military production for civilian needs but, on the contrary, the active usurpation of non-military technological projects by militarized branches. "Many more by-products of civilian research have been used for military purposes than the reverse," the UN report on "Economic and Social Consequences of the Arms Race and Military Expenditures" says. "What is important is how little, and not how much, the civilian sector has gained from military research and development."[22]

Therefore, the SDI program does not conflict with the main areas of scientific and technical progress but introduces a militaristic element which helps to step up research in fields with a possible quick practical return. The result is a distorted perception of the latest achievements of the technological revolution in the American economy, which is being geared more and more to material and technical support for the U.S. administration's military-strategic plans.

The functional orientation of research and development has undergone a further change in the direction of a higher percentage of applied research than basic R & D and of military-space research than civilian projects. Over the long range, the orientation of technological development toward not fully mastered principles or even hypothetical discoveries could slow down the work on the SDI because of the limited material foundation of basic research. Furthermore, a relative lag in theoretical projects will also have a negative effect on civilian research and it will have to be concentrated in a small group of technological fields to maintain the status quo for American products in the main civilian high technology markets.

The development of various elements of the space "defensive" system, some of which have already reached the stage of operational testing or the construction of models, is not the same as the creation of the whole system. The technology of so-called "systems architecture"—i.e., methods of combining various ABM components and coordinating their management, without which the "space shield" might never be completed—still constitutes the most complex and least developed elements of the SDI.

Finally, the scales of the possible technological breakthrough as a result of the SDI program will also depend on the actual scales of research funding. In view of the fact that military capital investments are no more than 10 percent as effective as investments in civilian research from the standpoint of scientific and technical progress, comparable scientific achievements will cost the United States 10 times as much as if they had been part of civilian programs. The escalation of military-space preparations, intended to start a new round of scientific and technical progress in the United States, will eventually have a boomerang effect on the American economy.

Footnotes

1. NEW SCIENTIST, 12 December 1985, p 18.

2. P. Mische, "Star Wars and the State of Our Souls. Deciding the Future of Planet Earth," Minneapolis, 1985, p 3.

3. "The Militarization of High Technology," edited by J. Tirman, Cambridge (Mass.), 1984, p 136.

4. U.S. NEWS AND WORLD REPORT, 9 December 1985, p 50.

5. "Empty Promise. The Growing Case Against Star Wars," edited by J. Tirman, Boston, 1986, p 47.

6. NEW SCIENTIST, 12 December 1985, p 18; FORTUNE, 23 June 1986, p 112.

7. L'EXPRESS, 5 February 1987, p 51.

8. ARMED FORCES JOURNAL, 13 march 1986, p 18.

9. L'HUMANITE, 7 May 1985.

10. EUROPEO, 22 November 1986, p 77.

11. AVIATION WEEK AND SPACE TECHNOLOGY, 14 July 1986, p 30.

12. Ibid., 12 January 1987, p 26.

13. SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA, 1985, No 1, p 59.

14. U.S. NEWS AND WORLD REPORT, 27 October 1986, pp 20-21.

15. For more detail, see SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA, 1986, No 9, pp 112-117.

16. THE NEW YORK TIMES, 15 June 1986.

17. SUEDDEUTSCHE ZEITUNG, 4 December 1986.

18. "New Economic and Social Implications of the Arms Race. Dangers and Challenges," WFSW, Studies of the Disarmament Committee, Berlin, 1986, p 22.

19. THE PHILADELPHIA INQUIRER, 17 December 1986.

20. AVIATION WEEK AND SPACE TECHNOLOGY, 10 February 1986, p 27.

21. "New Economic and Social Implications...," p 27; DER ZEIT, 26 April 1985, p 4.

22. "Economic and Social Consequences of the Arms Race and Military Expenditures," New York, 1982, p 44.

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U.S. Economy and Developing Countries

18030006b Moscow SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA in Russian No 2, Feb 88 (signed to press 21 Jan 88) pp 33-40

[Article by Nikolay Vyacheslavovich Volkov, candidate of economic sciences and sector head at the Institute of U.S. and Canadian Studies: "The Developing Countries and the Structural Reorganization of the U.S. Economy"]

[Text] The economic relations of the United States and other leading Western states with the developing countries have traditionally been based on monopolist capital's need for the natural, productive, and human resources of Asia, Africa, and Latin America. The economic strategy of imperialism in relation to colonial countries and later to political independent developing countries is still being reproduced today in its most general forms.

In spite of this, substantial changes are taking place today in the relations between the center and the periphery of the world capitalist economy. Economic contacts based on the mutual commercial benefit of partners are playing a more important role in them. Of course, this does not mean that exploitation—a salient feature of the capitalist structure—is disappearing from the interrelations of the United States and other Western countries with the developing countries. "But the use of the resources of others by neocolonial methods, the authoritarian behavior of transnational corporations, the bondage of indebtedness, and the debts running into the trillions, which obviously cannot be repaid, are leading into a blind alley," General Secretary of the CPSU Central Committee M.S. Gorbachev remarked. "This is giving rise to serious problems even among the capitalist countries themselves."[1]

The search for a way out of this contradiction is forcing the West to choose alternatives to ineffective forms of neocolonialism. Many earlier methods of exploitation, including the most odious, are gradually disappearing. The economic contacts of developed capitalist and developing states are being rebuilt on the basis of principles characteristic of the economic relations between Western countries, where economic strength and the effectiveness of capital use are the main factors.

In the 1970s and 1980s American monopolies worked out several flexible and effective means and methods of attaching the emerging countries to their own reproductive process.[2] What is important today, however, is not just the modification of forms of exploitation, but the fact that the structural reorganization of the leading economy of contemporary capitalism has given rise to significant qualitative changes in U.S. economic relations with the developing countries. Soviet researchers, however, have not begun examining this matter in earnest.

The Onset of a "New Imperialist Order"?

The United States has the most powerful economic machinery to influence the development of the emerging countries. It gives the American Government and monopolies many more opportunities than other imperialist centers to regulate and control the reproductive process in young states. The transnational corporations and banks of the United States are the main investors, suppliers of technology, and lenders in the developing world, the American domestic market is the largest and most appealing for the exports of the emerging countries, and U.S. goods and services are among their chief imports. The system of American neocolonialism took shape and developed on these three bases until recently. The functioning of this system, however, was influenced considerably in the 1980s by structural changes in the U.S. economy. The scientific and technical renovation of production potential and the reorganization of the system for the state-monopolist regulation of foreign economic relations greatly enhanced the competitive potential of American goods in the Third World markets. The changing structure of public demand in the United States has forced the developing countries to seek new ways and effective means of penetrating the American market; the competition for this market among emerging states has grown quite intense. All of this has increased the dependence of the periphery of the world capitalist economy on the progress in U.S. economic modernization.

The exclusion of inefficient production units from the reproductive process has made U.S. needs for the economic potential of developing countries different from those of the 1950s, 1960s, and 1970s. Now the emphasis is on the establishment of technological systems similar to American ones in the developing countries in order to eliminate several difficult problems in the standardization of goods imported from the young states and to give monopolies considerable advantages stemming from the conservation of resources used in production in enterprise headquarters within the country and their branches in Asia, Africa, and Latin America.

Therefore, in those developing countries where American TNC's were directly involved in the creation of enclaves of large-scale capitalist production, a technological model, different from the model of the 1960s and 1970s and designed to satisfy new production needs and consumer demand in the United States, is being created under the influence of the structural changes in the U.S. economy. This model is clearly geared to the latest technology of the leading capitalist states and the application of the latest capitalist principles of organization and management to all cycles of the reproductive process. For the young states the advantages of using new technology are connected with the guaranteed retention of their position in the world market and, in particular, the retention of American clients and the quicker attainment of what Soviet economist A.Ya. Elyanov has termed "modern standards of labor and leisure."[3]

One indicative example of the use of new forms of production organization in the developing countries is the rapid growth of joint ventures with TNC's within their territory. For example, in South Korea the American General Motors and Chrysler automobile companies established high technology enterprises jointly with the large Daiwa and Samsung local automobile companies in the middle of the 1980s for the production of spare auto parts and various components for plants located in the United States. Ford took a slightly different route: In conjunction with the West German Volkswagen firm, it established the Autolatina firm for the production of motor vehicles in Brazil and Argentina.

The same process is going on in the extractive branches of industry in the developing countries. This was promoted by their perceptible failures in the independent sale of raw materials. The return of the TNC's, especially American firms, to the extractive industry in the Third World as "risk partners" was also made possible by radical changes in the financing mechanism. In the 1960's direct investments accounted for 70-90 percent of the assets of American TNC's financing the mining and primary processing of crude minerals in the developing countries, but by the beginning of the 1980s the figure was just over 30 percent. Loans and credits accounted for the remaining portion.[4]

The return of the TNC's to the direct exploitation of crude resources in the emerging countries has actually taken different forms: the extension of loans and credits with the simultaneous augmentation of their role in the contracted management of mining enterprises, the extensive provision of these enterprises with mining, drilling, and refining equipment from the United States, active assistance in marketing, long-term contracts for the sale of raw materials to American corporations, and the leasing of nationalized mining enterprises. All of this is giving American raw material companies additional leverage to influence world raw material prices in the interest of the corporations of the U.S. processing industry connected with them either by capital or by production.

The structural changes in the American economy have made the developing countries much more dependent on the United States because rapid technological renewal is widening the gap between the comparative advantages of American capitalist production and production in the emerging states, including the new industrial states. The hope of avoiding a more pronounced technological gap led to substantial financial expenditures by developing countries for the purchase of advanced technology from American monopolies so that they could keep up with the United States, which has accounted for more than one-fifth of the trade of the developing countries in the 1980s. Trade restrictions were relaxed for these monopolies, and the legal statutes governing American capital's access to economic spheres of strategic importance to the emerging states were liberalized.[5] This stronger technological dependence, however, was accompanied by dramatically increased financial dependence on the United States. Of course, payments for Western technology (UNCTAD experts estimate them at around 20 billion dollars) constitute a comparatively insignificant part of the total debts of the developing countries, but the incorporation and efficient use of advanced technology in an underdeveloped economy required additional expenditures, and quite substantial ones, throughout the economy (to bring related sectors up to the necessary level, to develop the infrastructure and sales network, etc.).[6] For this reason, the purchases of Western technology have had a strong compounding effect on the debts of the emerging countries. The approximately 350 billion dollars the Third World has borrowed from governments and private financial institutions in the United States reflect the price the emerging countries have had to pay for the transition to the technological model imposed on them by American capitalism.

Not all of the developing states are capable of a quick and painless move to modern technological processes: The differences in their levels of socioeconomic development and positions in the system of international capitalist division of labor, and consequently in the interests of imperialist powers, are too great. All of them, however, are experiencing some technological pressure from the United States, which is making use of the global nature of scientific and technical progress to establish a technological model meeting its own interests in the developing countries.

Some of them, especially the new industrial states, are reacting to this pressure by modernizing their enterprises with the aid of foreign (mainly American) capital and technological expertise in order to maintain their competitive potential. Others, and these are the majority (around 40 of what have been termed the poorest countries and around 50 countries with a per capita annual income of no more than 500- 700 dollars), have neither the necessary manpower and resources nor a relatively developed industry and infrastructure and have therefore chosen to develop an independent technological system. These are the models of socioeconomic development based on the concepts of "basic needs" and "self-sufficiency," concepts which are quite popular in the emerging states. Under present conditions, however, the prospects of this pattern of development are uncertain. While the new industrial states, not to mention the Western countries, are moving far ahead on the cutting edge of scientific and technical progress, the continued use of labor-intensive technology in most parts of the developing world is erasing the appreciable comparative advantages these regions had until recently because of their cheap labor and easily accessible crude minerals. In this situation, they will sooner or later have to make the transition to progressive high technology methods of production, although this transition will not guarantee a change in their subordinate role in the science-intensive system of international capitalist division of labor. What will this transition entail?

It is most likely to depend on the possibility of obtaining technology from the West, especially from the countries determining the directions of scientific and technical progress, primarily the United States. For this reason, the technological re-equipping of the industrializing countries of Asia, Africa, and Latin America is beginning to depend more and more on the structural changes in the U.S. economy and the reordering of American monopolist capital's foreign economic priorities. Even today the United States is already doing much to secure an acceptable technological level in the developing states whose industrial and resource potential can become an organic part of the new international technological system American imperialism is creating.

There is every reason to assume that the structural changes in the United States will establish an international imperialist technological order which will be more progressive but equally unfair to the developing countries. Within the bounds of this order, American capitalism has been using the national resources of developing countries on a much broader scale, especially the national wealth based on contemporary industrial technologies.

The Distinctive Features of the New Division of Labor

The extensive use of the achievements of scientific and technical progress by the developed capitalist countries considerably reduced their demand for energy resources from the developing world. The introduction of resource-saving technology contributed to the rapidly widening gap between the advanced imperialist economy and the economies of the developing countries producing raw materials or technologically simple goods. The centers of the world capitalist economy made a transition from resource-absorbing to resource-conserving production and increased the science-intensiveness of products, while the periphery essentially sought ways of adapting its raw material base to meet capitalism's new needs.

The divergence of the two poles of the world capitalist economy helped the United States reduce the cost of the structural changes in its economy considerably. In the 1970s and 1980s the United States was able to reduce its proportional requirements for most of the main metals substantially. As the largest buyers of metals, American companies have traditionally had the greatest influence on world prices. The considerable reduction of the metal requirements of their production caused the sharp decline of world ore and metal prices in the 1980s: In the middle of 1986 they were around 25 percentage points below the 1980 level. The declining prices allowed American companies producing and using metal-intensive products to save money for the restructuring of technological processes. For example, the companies producing copper cable for telecommunications (these accounted for 70 percent of the demand for this cable) began the more economical production of fiber optics. They continued, however, to import the copper they needed at low prices from the developing countries, particularly to satisfy the increasing demand for copper wire for companies installing equipment in private dwellings for subscribers. In this way, the developing states which had to ship copper to the United States at unfavorable prices helped to reduce the overhead costs of American companies and allowed them to save even more because of the difference between the low world prices of copper and the rising domestic prices of the products manufactured from it.

It must be said that high raw material prices gave American corporations the incentive to make the transition to resource-saving methods of production. For example, the rising cost of zinc led to the development and active use of the pressure sheet formation technology in American industry for the production of items made of this metal. As a result, the amount of zinc used in the U.S. automotive industry decreased by 13.2 percent between 1970 and 1984. The new methods of producing aluminum and gold foil, which were largely a reaction to the rising price of bauxite, considerably increased the amount of aluminum packing material produced from one ton of metal in the United States over the last 10 years.[7] At the same time, plastic began to be substituted for aluminum in many branches of industry, and this also required considerable changes in the technology of plastic production and use. The extensive use of scrap metal in smelting (in 1985 almost half of all the steel in the world was smelted from scrap) also reduced the U.S. demand for many metals from the developing countries. There is no question that the soaring oil prices in 1973-1974 and in 1979-1980 contributed much to the American corporations' stepped-up transition to energy-saving technology (although it is evident that they would have done this eventually even without the "oil crises," under the influence of scientific and technical progress).

In turn, the development of high technology production in the United States, the increased scientific input in traditional branches, and the transfer to resource-saving methods of production in the American economy caused the developing countries to reconsider several of the postulates of their development strategy in industry and agriculture. Many of them consciously agreed to become part of the microelectronic technological chain of American corporations. For example, Thailand, Indonesia, Barbados, and El Salvador, which began developing an electronics industry with the aid of primarily American and Japanese corporations in the middle of the 1970's, are concentrating on the re- export production of semiconductors. Brazil, Mexico, and India are working on programs for the computerization of their economies and are rapidly developing a national electronics industry. This, however, is reinforcing their attachment to the U.S. market and to the technology supplied by American corporations. Brazil, for example, sent 27 percent of its exported computer chips to the United States in the beginning of the 1980s. The largest Western TNC producing semiconductors in Brazil is the American Ford Philco company. After the devaluation of the peso in 1980, Mexico became one of the regions of semiconductor production with the greatest appeal to TNC's because of declining labor costs. Virtually all of the main foreign contractors in this field are American companies. Furthermore, they are engaged mainly in the manufacture of electronic components (transistors and rectifiers account for 40 percent of the American imports of semiconductors from Mexico) and in their shipment to the United States. One example of this is the American IMEC company, which produces chips in Mexico for 24 plants belonging to large American TNC's, including ITT, Xerox, TRW, and Hughes.

The position of American electronics TNC's in Mexico is based on 100- percent ownership of the stock in their branches. The well-known American Intel, Fairchild, Motorola, Solitron Devices, and International Rectifier firms are building a network of assembly plants on these terms. The proximity of the American market and the possibility of saving on shipping costs were the reasons why Apple Computer and Hewlett-Packard chose to open plants in this country in the 1980s for the assembly of computers and their subsequent export to the United States and other countries.

The hope of optimizing and increasing the profitability of domestic and overseas production caused the TNC's to revise their relations with the developing countries where the manufacture of electronics had been organized by American monopolies back in the early 1960s. For example, Hong Kong, where Fairchild opened the first semiconductor plant in Asia in 1962, led the region in semiconductor exports to the United States until the middle of the 1970s. At the beginning of the 1980s it already ranked sixth among the main suppliers of semiconductors to the American market in the developing world. The same Fairchild company is gradually moving its enterprises to South Korea and to the Mactan export zone in the Philippines. The main reason is the rising cost of labor in Hong Kong, which virtually nullified the advantages of the customs privileges in Hong Kong in the 1980s. Singapore and Taiwan are encountering similar problems. Malaysia and the Philippines replaced them successfully in the 1980s on the conveyor belt of the American worldwide electronics business in the manufacture of simple products and various semimanufactured goods. At the same time, the American TNC's converted plants in Singapore, Taiwan, and South Korea for electronics production requiring highly skilled labor. To improve the quality of products—from electronic components and circuits to electronic games, video arcade machines, and computers—the TNC's offered considerable support for government programs in these countries for the development of the electronics industry. For example, Hewlett-Packard, AMI, Fairchild, Western Digital, Data General, and Digital Equipment are offering financial, technological, scientific, and technical support to the Electronic Technology Institute founded in South Korea in 1979.

By imposing the production of electronic semimanufactured products and consumer goods on the developing countries, American corporations are concentrating their resources in research and development and the production of advanced high technology industrial and informational electronics. The automated flowline technology developed in the United States is quickly making electronics one of the leading industries in terms of the quality of tools of labor and is securing a material basis for the new technological thinking in all segments of the labor force. The developing countries, on the other hand, have been put in the position of "apprentices" and are facilitating the American capitalist economy's transition to microelectronic technology.

Radical changes are taking place in the division of labor between the United States and the developing countries and are creating new patterns of interdependence. This is particularly apparent in U.S. relations with the new industrial states, which are becoming direct participants in the reproductive process in the American economy. South Korea and Taiwan, for example, send 40 percent and 50 percent respectively of their exports to the United States. According to estimates, in 1987 the American negative balance of trade with these countries amounted to 25 billion dollars, as compared to 22.8 billion in 1986.[8] The largest countries of Latin America—Brazil, Mexico, and Argentina—are just as closely attached to the U.S. market, and their multibillion- dollar loans from American government and private banks are not only profitable investments for the United States but are also having a positive effect on the operations of branches of American monopolies in this part of the Third World by stimulating domestic consumer and production demand in the borrower-countries.

Another factor influencing the structural changes in the American economy is the flow of capital from the developing countries to the United States. In the 1980s around 100 billion dollars was transferred from Latin America to U.S. banks; an estimated 3-4 billion dollars is exported annually from Hong Kong. Several of the new industrial states have begun making direct investments in the United States. India, Taiwan, and South Korea, for example, are investing in ventures in Silicon Valley.

The dynamics of raw material prices and the acceleration of scientific and technical progress are also having a perceptible effect on another important sphere of U.S. relations with developing countries—agricultural trade. According to the estimates of prominent American economist P. Drucker, if the relationship between the prices of manufactured goods and raw materials (with the exception of oil and petroleum products) in 1985 had been the same as in 1973, the deficit in the U.S. balance of trade would not have exceeded 100 billion dollars, as compared to the actual figure of 150 billion in 1985, and exports of American agricultural products would have produced twice as much revenue for the United States. Conversely, Japan's income from foreign trade would have been 20 percent lower, and Brazil's export profits would have been approximately 50 percent higher in the last few years.[9] It is probable that the foreign debts of developing countries, and possibly of the United States, would not have grown at such a rapid rate.

The decline in the world prices of agricultural raw materials is connected primarily with scientific and technical progress in agriculture in the developed capitalist and developing countries. The latter considerably reduced harvest losses by instituting some not immediately apparent but effective "minor infrastructural innovations." For example, the once seemingly hopeless acid clay soils of the Brazilian plains and Peru are now being used for the cultivation of large harvests of high-quality rice. In India the infrastructural harvesting technology immediately aided in reducing losses at processing plants by 20 percent in recent years.[10] In general, because of scientific and technical progress, agricultural production in the capitalist countries has been growing more quickly than their populations.

In this situation, although the United States is still the largest producer of agricultural products, it could not sustain monopoly prices and, consequently, earn excessive profits from sales of these products on foreign markets. For this reason, it has had to increase the size of government subsidies for its exporters of agricultural goods considerably and to initiate programs to reduce national agricultural surplus. This is establishing new conditions of capital reproduction in this sector of the U.S. economy.

In all probability, the developing countries have not made use of all of the advantages of new scientific and technical achievements in their agriculture. As their agricultural self-sufficiency increases and the surplus sold on the world market grows, they will exert more pressure on world prices. In connection with this, the competitive potential of U.S. agriculture will be directly dependent on the speed of its reorganization, which could reduce proportional overhead costs in national prices substantially. The pressure exerted by the developing countries has become a long-term external factor contributing to its modernization.

Therefore, the developing countries are influencing the structural changes in the American economy through changes in their role in international capitalist division of labor. The development of the new technological relations which are being established primarily under the influence of the United States is involving them more and more in the reproductive process of American monopolist capital. This is heightening the economic interdependence of the United States and the developing countries and, consequently, is increasing American capitalism's opportunities to use productive forces in the Third World to speed up the restructuring of its economy and the establishment of the new technological method of production.

Footnotes

1. M.S. Gorbachev, "Oktyabr i perestroyka: revolyutsiya prodolzhayetsya" [October and Perestroyka: The Revolution Continues], Moscow, 1987, p 50.

2. R.I. Zimenkov, "Amerikanskiy neokolonializm na sovremennom etape" [Current Phase of American Neocolonialism], Moscow, 1985.

3. MEMO, 1984, No 5, p 112.

4. THE CTC REPORTER, Autumn 1986, p 20.

5. In 1984, for example, India abandoned the practice of not granting the status of an Indian company to any firm in which 100 percent of the stock belonged to foreign shareholders. Interra Exploration, an American company, was the first to be granted this status. The Indian branch of this company, which produces electronic components, received all of the production and sales advantages of local firms.

6. N.V. Volkov, "Sistema torgovo-ekonomicheskoy ekspluatatsii razvivayushchikhsya stran" [System for the Trade and Economic Exploitation of Developing Countries], Moscow, 1984, ch 4.

7. In the 1970's and 1980's the domestic market for aluminum packing and packaging materials was one of the most rapidly growing markets in the United States. By the beginning of 1985 it was absorbing 26.2 percent of all shipments of aluminum to the country, as compared to 6.8 percent in 1960 (IRON AGE, 7 February 1986, p 23).

8. Calculated according to data in: BUSINESS WEEK, 11 May 1987, pp 27- 28; INTERNATIONAL HERALD TRIBUNE, 11 May 1987.

9. FOREIGN AFFAIRS, Fall 1986, p 771.

10. Ibid., p 772.

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Canadian View of Nuclear-Free Arctic

18030006c Moscow SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA in Russian No 2, Feb 88 (signed to press 21 Jan 88) pp 41-50

[Article by Hanna Newcombe: "Nuclear-Free Zone in the Arctic (The Canadian View of the Problem)"; first two paragraphs are SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA introduction]

[Text] In a speech in Murmansk, the capital of the Soviet Arctic zone, on 1 October 1987, General Secretary of the CPSU Central Committee M.S. Gorbachev appealed to the northern countries for a long-overdue discussion of the issue of Arctic security. "The Soviet Union," he stressed, "advocates the radical reduction of the level of military confrontation in the region. Let the north of our planet, the Arctic, be a zone of peace. Let the North Pole be a pole of peace. We request all of the states concerned to begin negotiating the limitation and reduction of the scales of military activity in the north in general—in both the eastern and the western hemispheres." The Soviet program M.S. Gorbachev set forth in Murmansk for military detente in the north and the extension of confidence-building measures to the entire Arctic zone includes the following specific undertakings: the guarantee of a nuclear-free zone in northern Europe; the limitation of naval activity in seas adjacent to northern Europe; peaceful cooperation in the exploitation of northern and Arctic resources; the scientific study of the Arctic; cooperation by the northern countries in environmental protection; the opening of a northern waterway for foreign ships.

The views of our Arctic neighbors, including Canada, on the issue of Arctic security are of interest in light of these new Soviet initiatives. The editors are offering the opinion of Hanna Newcombe, a Canadian specialist in this field, to the readers for their consideration. H. Newcombe is one of the administrators of the Peace Research Institute in Dundas, Ontario.

The Antarctica Precedent

Since 1961 the world has had a demilitarized and inspected zone in Antarctica.[1] Twelve states (the United States, the USSR, Great Britain, France, Japan, South Africa, Australia, New Zealand, Argentina, Chile, Belgium, and Norway) pledged not to emplace weapons in this region and assumed a commitment to allow complete international inspections of the region and to engage in peaceful cooperation for scientific purposes. This is one of the most successful arms control projects accomplished since 1945 under the conditions of an unbridled arms race.

Some of these states have territorial claims and have even had disputes over these claims in Antarctica (for example, Argentina and Great Britain), but the treaty has survived nonetheless. This experiment could probably be extended now to another region, a more important region as far as the interests of the great powers are concerned, a region where the possibility of armed conflict is more apparent. It would be symbolic if this region were to be located at the opposite pole of our planet, in the Arctic. It would be good if this proposal could be made by Canada, as an Arctic state. The others are Norway, Sweden, Finland, and Greenland (Denmark), and for this reason the initiative could also come from any of them.

The superpowers, the United States and the USSR, also have Arctic territories, but the Arctic disarmament initiative could hardly come from them because they are the main forces behind the arms race.[2] The basic idea of the Arctic treaty is that one of the smaller states in this region would suggest a plan, which would then involve the superpowers and would thereby help to restrain and curtail the arms race to some extent, at least in a limited region.

This is not a new idea: In 1964 it was proposed jointly by American and Soviet scientists, Alexander Rich and Aleksandr Vinogradov.[3] In their opinion, the regions covered by the Arctic treaty would be Alaska and northern Russia, as well as part of Canada, Greenland, Norway, Sweden, and Finland. The elimination of nuclear weapons or the disarmament (however it is defined) would be accomplished sequentially, either by regions or types of weapons or by a combination of the two. The first to be eliminated would be nuclear weapons and the means of their delivery, and the last would be radar detection systems, which could even be retained if necessary. The treaty on Antarctica could serve as a model. In view of the fact that there are many more military installations in the Arctic than there ever were in Antarctica, however, this decision would be a more significant (and more difficult) step toward disarmament.

The 1964 plan of the "two Alexanders" did not draw any clear distinctions between complete demilitarization (as in Antarctica) and the elimination of nuclear weapons. Since that time the idea of nuclear-free zones has been elaborated in greater detail and has been implemented in Latin America in the Tlatelolco Treaty.[4] This is why we should first clarify the differences between these two terms and only then move on to our proposal regarding the creation of a zone free of nuclear weapons in the Arctic instead of the more ambitious plan for its complete demilitarization.

Nuclear-Free and Demilitarized Zones

A zone free of nuclear weapons can be defined as a region in which nuclear weapons are completely nonexistent (whether under the control of the country to which the territory belongs or under the control of another state), and where a verification system secures the fulfillment of the agreement by all parties. Therefore, as Sverr Lodgaard noted in 1980, it envisages the nonpossession of nuclear weapons (as in the Treaty on the Non-Proliferation of Nuclear Weapons) and their nondeployment or non-emplacement.[5] Norway does not have any such weapons in peacetime, but by the terms of the NATO treaty they can be brought into Norway in wartime or even in times of crisis. Obviously, an agreement on a nuclear-free zone would preclude the emplacement of another country's nuclear weapons there in peacetime. The situation with regard to Norway represents a borderline case and has been the subject of much discussion. In any case, Lodgaard says that an agreement on a nuclear-free zone is at the point where horizontal and vertical non-proliferation meet, and this gives it a definite appeal to the supporters of serious arms control measures.

The demilitarized zone, or the "zone of peace," as it is sometimes called, can be defined as a part of the world where there are no weapons at all—neither nuclear nor conventional—and no military personnel, equipment, or bases.

At this time there are three zones free of nuclear weapons: outer space—in accordance with the 1967 Treaty on the Principles of the Activity of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies; Latin America—by the terms of the 1967 Tlatelolco Treaty; the seabed and ocean floor—in accordance with the 1971 Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Seabed and the Ocean Floor and in the Subsoil Thereof.

The 1959 Treaty on Antarctica is still the only example envisaging the creation of a demilitarized zone and a verification and inspection network, although it allows "the use of military personnel and equipment for scientific research."

The less ambitious option—i.e., the zone free of nuclear weapons—is proposed as the first stage in the Arctic. There are already enough problems to solve during the process of the establishment of this zone, and it would be wrong to compound them with the demand for complete demilitarization. One such problem is the transit shipment of nuclear weapons by land, sea, air, or space. Here it would be pertinent to discuss the status of the three existing nuclear-free zones.

The treaty on outer space prohibits the emplacement of weapons of mass destruction on satellites in orbit and on celestial bodies. It does not prohibit the flight of these weapons through outer space on intercontinental ballistic missiles or in lower orbits. It also does not specifically prohibit the destruction of non-offensive (reconnaissance) satellites with nuclear weapons launched from the earth. These loopholes are becoming a problem.

The treaty on the seabed also prohibits the deployment of weapons of mass destruction on the seabed and ocean floor, but does not say anything about weapons in a water column or on the surface of the water--i.e., nuclear weapons on submarines and surface ships. They can be described as weapons "in transit" and therefore not illegal.

The Tlatelolco treaty also permits the transit shipment of nuclear weapons through the zone by sea, and this probably applies primarily to American weapons transported through the Panama Canal.

In these three spheres (outer space, the seabed, and Latin America), nuclear weapons have never been deployed by methods prohibited by the treaties. Therefore, these agreements have not resulted in the elimination of any weapons. Some observers even suspect that they were concluded only because no great power intended to ever locate its nuclear weapons there. It is easy to promise not to do something that you have no intention of doing.

The Arctic nuclear-free zone would presuppose the actual elimination of the weapons located there (both American and Soviet). This would give rise to new arguments about arms control agreements. The proposals on the northern nuclear-free zone that were put forth by Finnish President U. Kekkonen and others (S. Lodgaard in 1980, A. Apunen in 1980, and J. Holst, P. Joenniemi, and A. Thunborg in 1975) applied only to Finland, Sweden, Norway, and Denmark, and possibly to Iceland. They did not envisage any real reduction of American or Soviet nuclear arms and concerned only the NATO obligations of Denmark and Norway to allow American nuclear weapons onto their territory in wartime or in a time of crisis. The renunciation of this obligation would be a serious step, but not one as far-reaching as the demand for the removal of the superpowers' nuclear weapons from Alaska, the Kola Peninsula, and Siberia. The hope of this reduction is the real purpose of the idea of a nuclear-free Arctic. The hope of actually reversing the arms race in this limited region goes far beyond the acknowledgement of nuclear-free status or insignificant changes in the terms of the NATO treaty.

Several other proposals on nuclear-free zones have also been made. For example, the Stockholm International Peace Research Institute (SIPRI) names the following zones from which nuclear weapons should be removed. The first are central Europe (the plans of Rapacki and Gomulka in the 1960s or the current campaign for the nuclear disarmament of Europe), the Balkans and the Mediterranean, the Indian Ocean (usually regarded as a zone of peace—i.e., a largely demilitarized zone), and the South Pacific. The second group consists of territories where the presence of nuclear weapons is suspected by neighboring countries—i.e., the Middle East (Israel). The third group consists of regions where the appearance of nuclear weapons is thought to be inevitable: South Asia (India and Pakistan) and Africa (South Africa). The fourth group consists of regions where the appearance of nuclear weapons would be possible in the event of a war (northern Europe). The report of this institute says: "Not one of these ideas has been the subject of negotiations. As a rule, these proposals have seemed either inconvenient or unjust to one side or the other. Besides this, the great powers are reluctant to agree to any restrictions on the emplacement of their nuclear weapons that might affect their global strategic interests."[6]

The final document of the first special UN session on disarmament (in 1978) devotes five paragraphs (60 through 64) to the issue of nuclear- free zones and zones of peace. It specifically mentions Latin America and zones in Africa, the Middle East, and South Asia. It mentions Southeast Asia and the Indian Ocean (the UN General Assembly has passed numerous resolutions on this matter) among proposed zones of peace (completely demilitarized zones).

Scandinavian Nuclear-Free Zone

The idea of the Scandinavian nuclear-free zone is the closest to our proposal because it would be territorially included in the nuclear-free zone in the Arctic. Their chief aims, however, differ. The Scandinavian zone, according to S. Lodgaard, is intended primarily to separate northern Europe from the rest of the continent in view of the obvious inclination of the superpowers[7] to "Europeanize" any possible nuclear war—i.e., to fight it on the European battlefield. In this way, it would represent an attempt to minimize Scandinavian losses if this kind of dreadful situation should arise. The Arctic nuclear- free zone, on the other hand, would be intended primarily to compel the superpowers to reduce their nuclear weapons at least in a limited region, thereby perhaps providing the momentum for subsequent reductions. Although the two zones would be created for slightly different reasons, they would have certain problems in common, and we will now take a look at these.

Lodgaard examines the problems of the northern nuclear-free zone from the following vantage points: the pledge not to deploy nuclear weapons; transit; the broader interpretation of nuclear-free status; obstacles impeding its establishment.

If Norway and Denmark were to pledge not to deploy nuclear weapons on their territory even in a time of war or crisis, the Soviet statement on the non-use of nuclear weapons (against any state having no nuclear weapons within its territory) would extend to them. Given the present state of affairs, however, it does not apply at times of crisis. As O. Apunen points out, if American nuclear weapons were to be brought into Norway at a time of crisis, this would certainly escalate and intensify the crisis.[8] (It almost sounds as though it would be better to have them there in peacetime, to avoid this escalation.) In the case of the Arctic zone, the non-deployment of nuclear weapons should be an essential condition from the very beginning. The free zone, or the buffer zone, is even more important in times of crisis than of calm.

In reference to transit, Lodgaard writes that by Scandinavian tradition, transit has been permitted by sea but not by land. Air transit should also be prohibited, especially for cruise missiles. This might also be a useful distinction for the Arctic nuclear-free zone. This would mean that submarines carrying cruise missiles, which would be impossible to verify in any case, would be allowed to cross the zone; the space flight of ICBM's would not be prohibited either. But any transit on land and, what is particularly important, any low-flying cruise missile would be prohibited.

The transit issue would be an extremely difficult problem in the Arctic nuclear-free zone, especially transit across the Arctic Ocean or on submarines under the ice cap.

The Arctic air space was extremely important in the 1950s, when bombers were the main carriers of the superpowers' nuclear weapons. A ban on air transit through the Arctic was then unthinkable because of the fear that no treaties would be observed in wartime. Intercontinental missiles reduced the strategic significance of the Arctic air space, but the improvement of cruise missiles could increase it. This could probably be prevented by the prohibition of air transit through the Arctic before it gains too much importance.

As for the crossing of the Arctic by submarines, this could be particularly important to the USSR, because it would allow Soviet submarines to sail from northern ports to southern waters. If the Arctic treaty were to motivate the Soviet Union to seek bases in southern regions more actively, it would be counterproductive. Furthermore, as far as the balance of power is concerned, the USSR should not be asked to make greater sacrifices than the United States, and this would apparently be the case if the crossing of the Arctic by submarines were to be prohibited.

Lodgaard favors the inclusion of the Norwegian antisubmarine equipment on the Scandinavian peninsula (Nordkapp). In other words, he believes that auxiliary installations of this kind should be removed from the

Arctic nuclear-free zone along with offensive nuclear weapons and their carriers. This should also apply to the nuclear-free zone in the Arctic, and this warrants further discussion.

One exceptional difficulty which also applies to the Arctic zone consists, as S. Lodgaard remarked, in the USSR's reluctance to include the Kola Peninsula and the nuclear installations there in any kind of Scandinavian nuclear-free zone—i.e., to remove these installations from there. No one knows if the Soviet Union would be more open to suggestions if the United States were to remove its nuclear equipment from Alaska. (This is not stipulated in the Scandinavian treaty.)[9]

O. Apunen discusses the "three waves" of the Kekkonen plan and the proposals on the Scandinavian zone (1962-1965, 1972-1975, and the Helsinki accords). The third wave began in May 1978, just before the special UN session on disarmament, and has not ended yet. All of these examples are relevant to the plan for the Arctic zone: They show how much time it takes to advance even the most modest plan and how difficult this can be.

A. Thunborg and S. Lodgaard stress that the nuclear powers' guarantees against the use of nuclear weapons are not the same as the creation of a zone free of nuclear weapons. What would this mean in an Arctic treaty to which the superpowers would be party? The declaration of guarantees of this kind would be useful, but it would not play the decisive role because the chief aim of the Arctic treaty would be a general reduction of arms, and not the minimization of territorial losses in the event of nuclear war (which is the aim of the proposals on the Scandinavian treaty).

In 1974 the UN General Assembly appointed a working group of experts to begin a comprehensive study of the concept of nuclear-free zones at Finland's suggestion. The group worked from 23 June to 18 August 1975, the results of this work were reported, and when SIPRI commented on them in 1976 it noted that agreement was reached only on a few trivial principles. The main points of divergence concerned: 1) the degree of freedom from nuclear weapons, 2) the boundaries of nuclear-free zones, 3) verification, and 4) the responsibility of states outside the zones.

The first disagreements were over the prohibition of peaceful nuclear explosions as well as nuclear weapons in the nuclear-free zones (as in the case of the nuclear non-proliferation treaty). This would probably not be a serious issue in the case of the Arctic treaty because the economic impact of nuclear explosions here would be minimal or non- existent as they would cause radioactive pollution. It is usually the developing countries that want to retain the right to choose, but the countries in the Arctic zone are all industrially developed states.

The second disagreement was over the boundaries of the zone. The main objection, voiced this time by the developed naval powers—the United States, Great Britain, and the USSR—was evoked by the inclusion of the open seas in any nuclear-free zone. They wanted to retain their traditional navigation rights. This is essentially a transit problem, and it has already been discussed in relation to the proposed Arctic treaty. We repeat, transit by ships carrying nuclear weapons through the Arctic Ocean or under its ice would probably be allowed.

The disagreement over verification concerned the creation of a new agency in addition to the IAEA. This could be a moot point in the case of the Arctic treaty, although the existing agency might be inadequate for the performance of this function.

The last point concerned the need for a formal commitment on the part of the nuclear powers not to use nuclear weapons against any of the states of the nuclear-free zone, which, as we already said, is not a decisive factor in relation to the chief aims of the projected Arctic treaty.

Military Installations in the Arctic

It is not easy to obtain reliable information about the existence of nuclear weapons and their carriers in this region. According to SIPRI, there is no question that the United States has nuclear weapons on board its antisubmarine submarines, which do make at least infrequent appearances in Arctic waters; it might also still have nuclear ammunition on board the Orion P-3 and B-52 planes (the same kind as at the time of the disaster involving the B-52 carrying nuclear bombs in 1968 in Thule, Greenland); the USSR probably has numerous nuclear weapons on ships and has conducted nuclear tests on Novaya Zemlya; Canada probably does not have any nuclear weapons at this time; Greenland has not had any since the airplane accident in 1968; Norway does not have any (but it might have the equipment for their storage); Sweden does not have any; it is highly improbable that Finland would have any.

Numerous command and control, communication, and reconnaissance systems connected with nuclear weapons are located in the Arctic, such as the satellite observation center and ballistic missile warning system in Thule and the loran towers used for the guidance of ballistic missiles (sea-launched)—in Bo and Jan Mayen (Norway), for example.

It is also possible that some parts of the early warning system in Canada are still operating, although the bombers it was supposed to defend were replaced by missiles long ago. The deployment of cruise missiles, however, could change the situation again.

As for the Arctic Ocean, in 1980 R. Byers expressed the opinion that there were no permanent bases under its ice cap. However, he went on to say, the future strategic significance of this Arctic region is still uncertain; breakthroughs in the methods of strategic antisubmarine warfare could increase its significance in the future, particularly for submarines. At present, strategic considerations are of little importance, however, and this could work in favor of the creation of a nuclear-free zone here. This is also attested to by the technological developments in the strategic sphere in the last two decades. The removal of nuclear weapons from the ocean will not necessarily affect the security interests of the superpowers, but this step could be an effective confidence-building measure, and there is a real need for it.[10]

We disagree with two points in R. Byers' line of reasoning. First of all, we anticipate real, although initially insignificant, strategic sacrifices from the superpowers. Otherwise, the Arctic treaty would not have much meaning. We do not need another "non-armament" treaty. Our second difference of opinion is that we propose the removal of nuclear weapons not only from the Arctic Ocean (as Byers does), but also from much of the contiguous land. The territorial boundaries of the proposed zone are discussed below. Besides this, Byers did not explain the differences between permanent bases and submarines in transit.

Dismantling of Arms in Arctic Zone

It appears that there are three categories of arms and that each should be treated differently:

a) Nuclear weapons and their carriers should be removed from the region as soon as the treaty goes into effect;

b) Installations which could be used as auxiliary equipment in the storage or launching of nuclear weapons, such as the previously mentioned possible storage facilities and loran towers in Norway or equipment in ports where missile-carrying nuclear submarines might be moored, refueled, or repaired, should also be removed, but over a longer period of time after the treaty goes into effect;

c) The warning systems intended for the transmission of information about an impending nuclear attack seem exclusively defensive. Furthermore, their presence in the region could actually have a stabilizing effect by assuring states that no attack is anticipated. National agencies, however, might not manage them in the best way possible. An international agency could be established to provide all states in the Arctic region, including the two superpowers, with information. For this reason, it might be best to leave this category of systems in place but to turn over their management to a new UN agency, which could be the forerunner of a future UN disarmament body. This would be better than relying on the already overloaded IAEA.

Treaty Parameters

It is understandable that the terms of the Arctic treaty would not extend to all of the territory of each signatory. The United States and the USSR would naturally[11] keep huge supplies of nuclear weapons in their non-Arctic territories. Other Arctic states would be affected less by the terms of the proposed treaty because they are non-nuclear states. They would only pledge not to deploy nuclear weapons within their Arctic territories (although it is probable that there are none there at the present time), to dismantle all auxiliary systems, and to hand over all warning systems to an international agency.

The geographic region covered by the treaty would be the area (land, water, and air space) north of the Polar Circle. This, however, would mean insufficient coverage of the land of many signatories. For example, less than half of Alaska would be free of nuclear weapons, Arkhangelsk in the USSR would not be included, etc. For this reason, the removal of all nuclear weapons north of 60 degrees North Latitude is proposed. This would include almost all of Alaska, the Yukon and Northwest Territories and part of the Ungava Peninsula in Canada, all of Greenland, Iceland as an absolutely new party to the treaty (with a NATO base), almost all of Norway and Sweden, all of Finland, the European part of the USSR north of Leningrad, and a large part of Siberia.

It would be best to make the geographic boundaries flexible and not to focus too much on the geographic latitude, so that superpower concessions can be balanced with a view to their sensitivity to matters of global strategy. Whole territorial units could be excluded from the zone while others could be included. The precise boundaries would be negotiable.

This kind of "flexible plan north of 60 degrees North Latitude" seems effectual and realistic. The parties would then be Canada, Greenland (Denmark), Iceland, Norway, Sweden, Finland, the United States, and the USSR. Whereas all of the territory of Greenland, Iceland, Norway, Sweden, and Finland would be included in the zone, only the northern regions of Canada, the United States, and the USSR would be covered by the treaty. In Canada the boundary of the zone could be conveniently set along the northern border of provinces, including only the territory north of this border. In the United States only one of the 50 states, Alaska, would be in the zone. In the USSR the zone boundary would not coincide with the border of any Soviet republic, but this would not be of any great importance. We should recall that Svalbard (Spitsbergen) was completely demilitarized by the terms of the 1920 treaty.

Ecological Issues

In June 1977 a conference of the native population was held in Barrow, Alaska. The Eskimo and Saami groups living in the Arctic zone discussed the issues of cultural heritage, education, public health, environmental safety, and technology and passed a resolution in favor of the establishment of a nuclear-free zone in their Arctic home. Concern about the Arctic environment was the main reason for the resolution. Teresa Pederson from Alaska, three-quarters Eskimo and one-quarter Swedish, was a delegate at the conference and presented evidence there, which was later cited by SIPRI (in 1978), that "the radioactive pollution of the Arctic region is almost completely of military origin, and the unique problems of this habitat must be taken into consideration." Radioactive fallout contaminates the lichen eaten in the tundra by caribou (Canadian deer) and reindeer. The meat of these animals is a staple of the Eskimo and Saami diet. "The result of this short food chain is that many natives of the American and Eurasian Far North have been exposed to biologically dangerous isotopes on a much broader scale than any other population in the world, with the exception of the inhabitants of Hiroshima and Nagasaki in August 1945."

Pederson spent summer 1978 working with UNITAR in New York on the further study of the problem of freeing the Arctic of nuclear weapons and discussing this matter with delegates to the special UN session on disarmament. The conference resolution won the support of several social organizations and the Vatican.

This initiative is connected with our proposal because environmental considerations are another argument, in addition to considerations of strategic security, in favor of the creation of an Arctic nuclear-free zone, and because it is supported by people who actually live in the zone, at least those represented at the polar conference. The implementation of the proposal will also be important in securing basic human rights and the right of self-determination.

Pros and Cons of Arctic Nuclear-Free Zone

The inclusion of the superpowers in the Arctic nuclear-free zone has its pros and cons. It has its cons because this is certain to make its creation more difficult, as the superpowers will have to sacrifice their strategic plans. But if this were not the case, what would be the point of a substantial disarmament plan? The whole point is to induce the most heavily armed states to reduce or convert their military installations somewhere. It is highly improbable that the plan would be adopted without the participation of the superpowers; with their participation the treaty would contribute to disarmament. The most intelligent course would be a reasonable compromise between acceptability and effectiveness.

One of the obvious advantages of the Arctic nuclear-free zone is that it would include only northern industrially developed countries and no developing states. The latter complained, and with good reason, that they were penalized unjustly by the nuclear non-proliferation treaty and that the highly militarized and/or industrialized countries also should have taken some kind of step toward disarmament long ago. The Arctic zone could be a partial response to this complaint.

It would be wrong to expect too much from the Arctic zone; it is unlikely to have a noticeable effect on the nuclear stockpiles and capabilities of the superpowers. The treaty would only be a means of separating the opposing nuclear forces and putting a little more distance between them. And even this would only have a psychological impact, perhaps as a confidence-building measure, because ICBM's could fly over the region, high up in space, with launching sites and targets south of 60 degrees North Latitude. The treaty could, however, be an important signal marking the beginning of a process.

At one time, in the 1960's, arms control experts spoke of "zonal disarmament"—i.e., the elimination of weapons from a single zone or their temporary removal from part of a territory to create trust while the process gained momentum. No action was taken on these ideas. We could now regard the "flexible plan north of 60 degrees North Latitude" as the first stage of global zonal disarmament. After nuclear weapons had been removed from the regions north of 60 degrees, we could extend the zone to 55 degrees, then to 50 degrees, etc. The same kind of movement could also start in Antarctica.

In the final analysis, this is the main idea of the zone free of nuclear weapons, or the zone of peace: It provides a laboratory or experimental test site to test methods of disarmament and verification for their subsequent global application.

Footnotes

1. This is a reference to the Antarctica Treaty, which was signed 1 December 1959 and entered into force 23 June 1961—Ed.

2. Subsequent events refuted the author's statement. The peace initiatives M.S. Gorbachev advanced in Murmansk with regard to Arctic security were a vivid example of the new way of political thinking in the Soviet Union—Ed.

3. BULLETIN OF ATOMIC SCIENTISTS, November 1964, pp 22-23; SCIENTIFIC AMERICAN, January 1965, pp 48-59.

4. In addition to the Tlatelolco treaty, there is also the Rarotonga treaty on the creation of a nuclear-free zone in the South Pacific (see SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA, 1987, No 1)—Ed.

5. BULLETIN OF PEACE PROPOSALS, 1980, No 1, pp 33-39 (S. Lodgaard is a prominent Norwegian expert on military policy and the director of the Norwegian Peace Institute—Ed.).

6. "SIPRI Yearbook 1976," pp 279-305.

7. The author's statement can apply only to the United States, which came up with the idea of "limited nuclear war" in Europe. As for the USSR, it has always objected to the very possibility of fighting any kind of nuclear war and has not only supported the idea of nuclear-free zones wholeheartedly but has even proposed a program for the elimination of all nuclear weapons by 2000—Ed.

8. BULLETIN OF PEACE PROPOSALS, 1980, No 1, pp 16-32.

9. The USSR also responded to this question with the far-reaching proposals in M.S. Gorbachev's speech in Murmansk in fall 1987. As for the previous remark by Lodgaard, it should be stressed that the Soviet Union has already unilaterally dismantled the medium-range missile launchers on the Kola Peninsula—Ed.

10. R. Byers, "Paper to Toronto Arms Control Group of Canadian Institute of International Affairs," 5 February 1980.

11. Advances in Soviet-American nuclear arms talks have exceeded even the author's most audacious assumptions. The term "probably" seems more apt here than "naturally"—Ed.

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Outlook for Engineering Careers in U.S.

18030006d Moscow SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA in Russian No 2, Feb 88 (signed to press 21 Jan 88) pp 92-100

[Article by V.Ye. Khrutskiy and M.M. Ivanov: "Engineering Career Problems"]

[Text] According to the data of the U.S. National Science Foundation (NSF), there are around 2.1 million engineers in the United States, including 600,000 in the processing industry—the leading branch of physical production.[1] It is significant that calculations of the number of engineers in the United States are based not on the specialization of personnel—i.e., on degrees or education—but on the functions they perform in their jobs. According to the classification system of the U.S. Bureau of Labor Statistics, workers employing scientific principles and theories and mathematical methods in the resolution of practical production and technical problems are categorized as engineers. Their main functions are the resolution of technical problems and the improvement of production organization. Their activity is a connecting link between science and production.[2]

When the administrators of industrial companies consider applications for engineering jobs, they look for a bachelor's degree or at least a diploma from a college specializing in mathematics and the natural sciences.[3] The graduate of an engineering school, however, must prove his right to an engineering position. The college graduate is awarded a diploma or, more precisely, an engineering license—something like a certificate of qualifications—only after 4 years of successful work in an engineering job (usually when he is at least 25 years old). The license is awarded by one of the professional societies (of mechanical engineers, technological engineers, etc.—there are more than 200 in all) after the candidate has passed a National Council on Engineering Education exam.[4]

The engineering degree only proves that the person acquired the necessary education and skills. It is not surprising that the total number of people working in the engineering profession in the United States is approximately 2.5 times as high as the number of people with engineering degrees. Therefore, the degree is not always necessary. Even people without a higher education but with considerable experience in production or a talent for invention are appointed to engineering positions.

The definition of engineering labor in American statistics is naturally quite abstract, but it indicates that the workers categorized as engineers in the United States perform functions differing in many respects from those performed by the overwhelming majority of people occupying engineering positions in our country. Engineers at our enterprises frequently do work which is performed by skilled laborers, foremen, or clerical workers in the United States.[5] This alone completely excludes the possibility of any direct comparison of the number of engineers calculated according to the American system of classification with the number of workers categorized as engineers in our statistics.

An understanding of the place and significance of engineering labor in modern production requires an analysis of its sectorial, professional, and functional structure. This kind of analysis can be based on data on the distribution of engineers in the American processing industry. According to statistics, most of these specialists are employed in machine building. More than two-thirds are employed in three industries (general and transport machine building and the electrical engineering industry).[6] The percentage of engineers in the processing industry as a whole is quite low, and they represent only 3 percent of all workers. The indicator is much higher, however, in the branches determining scientific and technical progress. For example, engineers represent 3.7 percent of all the people employed in the chemical industry, 5.1 percent in instrument building, 5.5 percent in petroleum refining, 6 percent in transport machine building, 7 percent in electrical engineering, and 14 percent in aviation. The corresponding number of production workers to each engineer is much lower. Whereas the indicator was 22 in the processing industry as a whole at the beginning of the 1980s, the ratio was 1:13 in general machine building, 1:12 in the chemical industry, 1:11 in transport machine building, 1:8 in the electrical engineering industry, 1:10 in instrument building, and 1:3 in aviation.[7]

These data indicate that there is a higher percentage of engineers in branches with a higher level of mechanization and higher energy and capital requirements. Between 1948 and 1981, for example, the average annual rate of increase in total "factoral" productivity (i.e., the combined effectiveness of the use of live and embodied labor) in the chemical and electrical engineering industries and instrument building amounted to 3.1 percent, 3.5 percent, and 2.7 percent respectively, as compared to an indicator of 2 percent for the processing industry as a whole.[8] The proportion accounted for by engineering labor in production in these branches ("engineering-intensiveness") is twice as great as the average for all industry. Why?

Above all, because there have been significant changes in the correlation of sources of production efficiency augmentation in American industry in the postwar period. Its dynamics now depend primarily on the technical and economic parameters of industrial equipment and technology and the correspondence of forms of labor organization and incentives to the new technical level. The effectiveness of industrial production is being enhanced mainly through an increase in the return on capital—i.e., in a savings on embodied labor (crude resources, materials, energy, and equipment)—per unit of final product. The proportion accounted for by wages (including the salaries of engineering and technical personnel and managers) in the final product of the processing industry has not exceeded 20 percent in the last 10 years. According to the estimates of American specialists, for example, the technical modernization of production accounts for 60 percent of the rise in labor productivity in the aviation industry. Another 25 percent is connected with the improvement of capital investment patterns, and only 15 percent is connected with a savings in live labor.[9]

Increasing the return on capital necessitates the improvement of machines and equipment, the technology and organization of labor, the accelerated incorporation of new equipment, etc. All of this is directly related to the work of engineers, most of whom belong to three professional groups: electrical engineers, mechanical engineers, and technological engineers. This is not surprising. After all, the new and more productive machines and tools of production are primarily a result of the labor of electrical and mechanical engineers. Electrical engineers (they include specialists in electronics and computers) represent the most quickly growing category of engineering personnel. Their work is connected with the development and incorporation of microelectronics and equipment for the automation and robotization of production. The work of mechanical engineers is connected primarily with the use of technological innovations in production. In branches of machine building their functions include the design of new machines, the improvement of existing machine tools and instruments, etc. In the opinion of NSF experts, the introduction of energy-saving technology now depends on the work of mechanical engineers.[10]

The real enhancement of production efficiency, however, requires more than just new and more productive technical equipment. It also requires the intelligent combination of new and old equipment and all types of production resources, including manpower, materials, semimanufactured goods, and so forth, in the production process. The performance of functions connected with the development of new tools of labor is an extremely important part of the engineer's work: Research and development account for 32.6 percent of all engineering work. Nevertheless, more than two-thirds of this work is still connected with various aspects of the improvement of production organization and management. This is the function of technological engineers. Their duties include time studies, expenditure analysis, personnel training, participation in the development and introduction of automated data processing systems and systems for the control of technological processes for the purpose of securing product quality control, reducing surplus stock, and optimizing the distribution of manufactured and semimanufactured goods, financial planning, and several other functions.[11] The quality of products and the constant renewal and improvement of product assortment are particularly important in the enhancement of production efficiency today. Functions connected with the improvement of quality are also part of the duties of technological engineers.

As American specialist E. Red has pointed out, "engineers must work in a dynamic environment requiring a well-rounded education and a certain amount of practical training and production experience. They must work with ideas, starting from abstract concepts, and then synthesize them in various types of innovations. Engineers must be able to work with machines, equipment, and technological structures; they must be able to work with people (including other engineers, managerial and technical personnel, clients, and representatives of government and public organizations). Constant contact with people is necessary for the transformation of engineering ideas into realities. Finally, they must also work with finances (budget projections, financial estimates, capital investments, and the cost of services and materials). This requires a knowledge of economics, which frequently determines engineering decisions."[12]

To perform his duties, the engineer needs not only knowledge and practical experience, but also opportunities to use them. This depends to a considerable extent on the engineer's prestige and status in production and on the organizational forms and incentives of engineering work. These are the primary factors influencing labor productivity. A high technical level relieves the engineer of the need to perform the routine and uncreative operations that frequently constitute the majority of the specialist's duties.[13] The productivity of engineering work is primarily a matter of intellectual productivity. This is why production efficiency now depends on an increase in engineering personnel (in comparison with other categories of manpower), the improvement of technical equipment and the organizational forms of engineering labor, and the intensification of the use of the creative potential of engineers in all fields.

Problems in the Organization of Engineering Work

The slower growth rates of labor productivity and production efficiency in general were largely a result of the so-called "crisis in American management,"[14] when the managers of many companies assigned priority to the short-term results of economic activity and were overly concerned with stock dividends and quarterly profits. Corporate decisions were less likely to entail large investments in new equipment and technology. "We have access to any technology," an executive of a large steel company said, "but putting our money in time deposits is often more profitable than the incorporation of new equipment."[15] This policy slowed down the technical modernization of production and the incorporation of scientific and technical achievements. This affected engineering employment patterns.

Whereas the number of engineers in the American processing industry rose by 88,000 in 5 years (1962-1967) and there was a corresponding increase in the percentage of engineers in the total labor force, in the next 13 years (1967-1980) the number of engineers actually decreased (especially in view of the fact that the total number of people employed in branches of the processing industry in the United States rose by 950,000 in the same years). As a result, the percentage of engineers among industrial personnel was lower in 1980 than in 1962. It was not until the beginning of the 1980's that the number of engineers began to rise as a result of structural changes in industry and their relative number exceeded 3 percent (see Table 1).

Table 1. Absolute and Relative Numbers of Engineers in U.S. Processing Industry

Categories	1962	1967	1975	1980	1982
Engineers, in thousands	489.6	577.5	507	571.4	588.1
Percentage of engineers in total number employed	2.92	2.99	2.76	2.82	3.12

Source: "Statistical Abstract of the United States, 1964," p 544; 1969, p 526; 1977, p 617; 1981, p 604; 1986, p 583.

The reduced "engineering-intensiveness" of production and changes in engineering employment patterns in American corporations were among the reasons for the reduction of the technological gap separating the United States from its main competitors. The percentage of engineers in electrical machine building in Japan, for example, is more than twice as high as in the United States.[16] Furthermore, it takes four American engineers to perform the same amount of work as three Japanese in a specific unit of work time.[17] Therefore, it is not surprising that labor productivity in this branch in Japan is 1.7 times as high as in the United States.[18]

The reduction of the quantity of engineering labor in the U.S. economy in the 1970s was accompanied by its less satisfactory use. Forms of labor organization and incentives ceased to correspond to the nature of engineering operations and began to influence their effectiveness adversely. The prestige of the profession declined. There were different signs of this. For example, although the starting salaries of graduates of higher academic institutions were approximately the same (6-7 dollars an hour), the young engineers had much worse income prospects and career opportunities than specialists in jurisprudence, marketing, accounting, finance, etc. It is not surprising that only a third of the presidents of the largest American companies had a technical education.[19] According to some estimates, 31 percent of the managerial and engineering personnel engaged in production in American companies wanted to change jobs, whereas the indicator was only 11 percent in such fields as finance and marketing.[20]

American experts are quick to point out the fact that it was precisely at that time that engineering labor began to be regulated much more closely and engineering decisions became subject to stricter administrative control. On the organizational level there was a gap between the creative side of engineering labor—i.e., between the engineer's ability to invent and design new technologies, machines, and products—and the engineer's opportunities to incorporate these items in production and arrange for the use of the new equipment and technology, thereby taking the idea all the way to production innovation. Innovation gradually lost its earlier significance and was replaced by paperwork and coordinating operations.

The objective changes occurring under the influence of scientific and technical progress in the organizational structures of large American companies (their transformation into scientific production associations with research services acquiring the status of independent organizational units) have intensified the specialization of engineering labor, but this process has had some bad points in addition to its good points. The engineering personnel of the research centers of corporations (under the direct jurisdiction of top corporate executives, vice presidents in charge of research and development, are engaged primarily in creative activity. Here innovation does not go beyond the creation of experimental models, and far from all of these have any promise of commercial success.

The engineering personnel engaged directly in production essentially take no part in the development of new technical equipment. The functions of plant engineers have gradually been reduced to the use of new equipment and technology in spite of the possible factors impeding their incorporation in connection with designs with an inadequate technological and organizational basis. And whereas all of the engineering services in small companies (not having their own research centers) are under the direct jurisdiction of vice presidents in charge of research and development, in large firms the research personnel are separated and the plant engineers are under the direct administrative control of production managers. As a result, the work of plant engineers is usually confined to the performance of routine functions. As a rule, they no longer care to take the risks connected with the introduction of major innovations, the full-scale modernization of equipment, etc.

Of course, the authority of production managers extends to engineering services even in small companies, but it is significant that these services are under dual jurisdiction: linear (production managers) and functional (vice presidents in charge of research and development). In large companies the research and production engineering services are essentially under different jurisdictions, and whereas the loss of the emphasis on innovation in research centers was connected to a considerable extent with their isolation from production, in the case of plant engineers it was connected with their increasing supervision by line management. The role of the plant engineer in American industrial firms in the 1970s and early 1980s began to converge with the work of the skilled laborer in terms of organizational status and degree of regulation, and frequently even in terms of the content of labor. The engineer in production lost his earlier reputation as a pioneer and explorer, a leader making independent decisions within the limits of his technical competence and position, and became associated in the public mind with "an anonymous soldier in the faceless army of corporate employees."

The increased regulation of engineering labor in large American corporations in the 1970s and early 1980s had a negative impact on its effectiveness, and this was reflected first in the restriction of the rights of engineers to make independent decisions with regard to production renovation. A survey of 3,000 engineers, conducted at the largest American corporations in 1986 by the American Association of Engineering Societies, is extremely indicative in this respect (see Table 2). The results of the survey indicate that dissatisfaction with the content and organization of labor is quite pronounced even among the engineers of such technically advanced companies as General Electric, Du Pont de Nemours, Texas Instruments, and Control Data. Virtually no demand made by engineers with regard to their work is given the necessary consideration by corporations. This is particularly true of real participation in decisionmaking.

Table 2

Conditions of effective engineering labor	Percentage agreeing with importance of condition in their jobs	Percentage reporting observance of condition in their jobs
Real participation in decisionmaking	88	31
Corporate interest in new ideas	92	52
Democratic style of management	94	46
Good communication between engineering services and managers	92	43
Salary system reflecting personal contribution of each engineer	89	46

Source: RESEARCH MANAGEMENT, 1986, No 6, p 4.

At the same time, the higher the technical level of production, the more technical competence the making of administrative decisions requires. This is why more and more of these functions are being turned over directly to engineers. Today they account for most of the engineer's work. The fact that they may have no connection with the final result of engineering labor is another matter. As American researchers of this topic are more and more likely to admit, the very ability of the engineer to act on new ideas and technical decisions depends on his opportunities to organize work independently and arrive at the final result without any stringent administrative control from above.

The declining prestige of engineers in the United States has also been connected to a certain extent with negative trends in incentives for engineering labor. The system of a regular salary plus bonuses in the majority of American companies in the 1970s and early 1980s was distinguished by a high percentage of regular wages (based on seniority) and the constant reduction of merit raises. According to the data of Soviet economist Ye. Medvedeva, whereas the correlation of the salaries of highly qualified engineers and engineers with average skills in 1963 was approximately 1:2.5, in 1983 it was already 1:1.5.[21] Given the relatively high average and starting salaries of engineers in the United States, this had a negative effect on productivity incentives. In 1986 the average annual salary of the engineer exceeded 43,000 dollars, which was approximately twice as high as the average wage of production workers in industry, and the maximum salary (for petroleum engineers) was 54,600 dollars.[22] Even the starting salaries of engineers are much higher than the average wages of production personnel. For example, the starting salary of a mechanical engineer or an electrical engineer in 1986 was from 1.2 to 1.7 times as high as the average wage of production personnel in general and transport machine building, the electrical engineering industry, and instrument building.[23]

The labor expenditures of the engineer, in contrast to the worker or office employee, cannot be precisely measured directly on the job—by the amount of time worked or the amount of finished items produced. The effectiveness of engineering operations can only be assessed with any degree of precision on the scale of the enterprise or company as a whole, by the amount of profit generated by a savings in live and embodied labor and the improvement of product quality as a result of engineering decisions. The size of the economic impact does not depend directly on the productivity of the engineer's labor or his level of skills. Setting measurement standards for creativity and innovation would be senseless. Only the engineer's growing financial and moral interest in the final results of his labor—i.e., in the commercial success of a new product or in the economic effectiveness of new equipment or technology—can have a truly stimulating effect. This, however, means that engineering labor in production must be free of any kind of bureaucratic regulation and control and must be placed above the authority of line management.

Freedom in the choice of work methods and independence in administrative decisionmaking must compensate, the president of one New York consulting firm maintains, for rigidity in the assessment of the final results of production.[24] In other words, economic forms of control must be substituted for administrative forms; the engineer's salary should depend strictly on the final results of the commercial activity of the enterprise. There is, however, another side to the matter. Far from all of the results of engineering labor can produce an impact in production the same year. It takes a long time to recoup the cost of more productive equipment and technology. In most American companies this fact is not taken into account fully in the organization of engineering salaries. As A. Marolda, the vice president in charge of corporate development of the Arthur D. Little firm, pointed out, in the 1970's and early 1980's it was typical for the president of an industrial firm with an education in high finance to tell his engineers: "If you want new equipment, get it, but remember that your bonuses will depend on this year's profits."[25] This approach robs the engineer of any incentive to look to the future and to solve major technical problems.

The tendency toward the transformation of corporations into scientific production associations and the gradual transfer of engineering services to the jurisdiction of vice presidents in charge of research and development in leading American companies have been accompanied by another trend in recent years. It is reflected in the attempts of corporate executives to make the activities of research and engineering services an organizational component of the overall results of enterprise production or commercial activity.

Some corporations have achieved this by subtle administrative methods. In some firms, for example, successful experiments have been conducted in the appointment of the heads of production divisions as assistant managers of design divisions. In this way, engineering and technical personnel are given a chance to influence production directly. The delegation of real power to engineers to participate in general corporate planning has also been recommended.[26] In another widespread practice, experimental production units are being put under the direct administrative supervision of engineering services, and so forth.

Many American experts on management have concluded from the data of numerous surveys that professional self-assertion is the main incentive in engineering work.[27] The improvement of the organizational forms of engineering activity in the United States has now acquired the features of a government-directed national campaign for the restoration of the "engineering culture." Within the framework of this campaign, government, business, and universities are working together to strengthen cooperation between universities and industry, support research and development in corporations, develop professional engineering associations, reorganize the system of engineering education, stimulate scientific and technical initiative and small business, formulate a code of engineering ethics, etc. All of these different areas cannot be discussed in an article of this length, but even listing them provides some idea of the mounting public interest in engineering career issues.

Of course, the elimination of administrative methods of managing engineering labor will be far from painless and it will be a quite contradictory process on the corporate level. This approach is being resisted at all levels of the corporate bureaucracy: from foremen to the highest echelon of management. And only the pressure of competition and the need to seriously consider the enhancement of production efficiency over the long range will force management (although even this will not be enough in all cases) to give up part of its power to engineers.

Footnotes

1. "Statistical Abstract of the United States 1986," p 582.

2. "Occupational Outlook Handbook 1980-1981," Washington, 1981.

3. At the end of the 1970's around 25 percent of the engineers in America had a master's degree and 5 percent had a doctorate. For the sake of comparison, in 1950 only 8 percent of the American engineers had a master's degree and 1 percent had a doctorate (E. Red, "Careers in Engineering and Technology," Monterey, 1984, p 104).

4. Ibid., pp 120-123.

5. In U.S. statistics foremen are categorized as production workers, and not as managers.

6. "Changing Employment Patterns of Scientists, Engineers and Technicians in Manufacturing Industries, 1977-1980," Washington, 1981, p 22.

7. Calculated according to data in "The National Industry-Occupational Employment Matrix, 1970-1978 and Projected to 1990," Washington, 1981, vol 1.

8. J. Kendrick, "Improving Company Productivity," Baltimore, 1984, p 90.

9. P. Sink, "Productivity Management," New York, 1985, p 280.

10. "Changing Employment Patterns...," pp 3-4.

11. E. Red, Op. cit., p 23.

12. Ibid., p 79.

13. For more detail, see SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA, 1986, No 6, pp 68-77.

14. "Gosudarstvo i upravleniye v SShA" [Government and Management in the United States], edited by L.I. Yevenko, Moscow, 1985, pp 21-47.

15. "Government and Innovation. Hearings..., U.S. House of Representatives, September 7, 8, 1979," Washington, 1980, p 353.

16. In Japan, with only half the population of the United States, around 90,000 engineers have graduated each year since the end of the 1970's. The United States, on the other hand, trains just over 60,000 engineers a year (J. Riggs and G. Felix, "Productivity by Objectives," Englewood Cliffs, 1983, p 51).

17. RESEARCH MANAGEMENT, 1987, No 1, p 4.

18. SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA, 1983, No 3, p 96.

19. HARVARD BUSINESS REVIEW, July-August 1980, p 75.

20. J. Riggs and G. Felix, Op. cit., p 242.

21. SOTSIALISTICHESKIY TRUD, 1986, No 10, p 109.

22. RESEARCH MANAGEMENT, 1987, No 2, p 5.

23. Calculated according to data in: IEEE SPECTRUM, 1987, No 2, p 18; "Statistical Abstract of the United States 1986," pp 748-749.

24. G. Pinchot, "Intrapreneuring," New York, 1985, p 161.

25. "The Reindustrialization of America," New York, 1982, p 55.

26. JOURNAL OF MANAGEMENT IN ENGINEERING, 1987, vol 3, No 1, p 56.

27. IEEE ENGINEERING MANAGEMENT REVIEW, 1986, No 1, p 59.

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Book Review: World Capitalist Crisis in 80's

18030006e Moscow SSHA: EKONOMIKA, POLITIKA, IDEOLOGIYA in Russian No 2, Feb 88 (signed to press 21 Jan 88) p 108

[Review by V.S. Mikhalev of book "Krizis mirovogo kapitalisticheskogo khozyaystva—80-ye gody" [Crisis in the World Capitalist Economy—1980's], edited by A.D. Borodayevskiy, V.P. Trepelkov, and V.I. Fedorov, Moscow, Mezhdunarodnyye otnosheniya, 1986, p 432]

[Text] How can the contemporary mechanism of world capitalist economic development be described? What will determine the distinctive features of this development in the years to come? The authors of this book try to answer these and other questions.

They associate the contemporary development of the capitalist economy with the spread of the directly international form of production and the creation of a corresponding monetary sphere by means of capital migration, the development of a world labor market, and the expansion of transnational corporations and banks. They reveal the contradictory essence of bourgeois science and its role in capitalism's mobilization of its reserves through the improvement of the regulation mechanism and the planning of structural policy.

The information in this book provides new arguments in favor of the perestroyka in our country. The need for the vigorous improvement of the production system with scientific and technical achievements is dictated in part by capitalism's current efforts to beat socialism in economic competition on the qualitative level—in the organization and technology of production, in labor productivity, and in product quality. The reader of this book will also find original ideas about the structure, subjects, and mechanism of the world economy and about the law of labor productivity as an economic basis securing an interest in cooperation for all countries.

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