

SCIENCE AND TECHNOLOGY AT THE TURNING-POINT FOUNDING THE TECHNOLOGICAL STATE

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Techno-Nationalism

Science and technology in Japan have reached a critical turning point in their evolution. The distinctively Japanese system of technology that developed after the Second World War, characterized by its close links to the private sector, is collapsing. In its place there now emerges a new technological order increasingly shaped by the dictates of national security and closely resembling the dominant mode of techno-scientific development in the West, with its locus in the military-industrial complex. The shift toward a new technical order finds its theoretical expression and justification in what may be termed techno-nationalism.

Technological convergence is part of a broader process of political change that has seen Japan emerge from the ruins of World War II to take its place alongside other industrial democracies as a full-fledged member of the Western world. Surpassing Western Europe in economic power, Japan's influence in the tripolar alliance that constitutes the Free World is now second only to that of the United States. Technical innovation has played an important role in this country's ascendance to economic superpower status. But today, Japan stands at a crossroads: the kind of technical progress its leaders opt to pursue from now on has far-reaching political as well as economic implications. This essay seeks to clarify the meaning and direction of technological change in postwar Japan. Examining the ideological and institutional antecedents of techno-nationalism, it focuses on the emergence in the early 1980s of the technology-oriented state and the period of transition, the recessionary 1970s, that gave rise to it.¹

State involvement in the development of modern science and technology in Japan may be traced through three phases. During the first phase, extending from the late 1930s until 1945, the massive military build-up of the war years dictated both the rhythm and direction of technical progress. The early postwar period (1945-1955) was a time of transition during which Japan rebuilt its economy and restructured its political and social systems. The population looked to science to provide shortcuts to social progress. But despite high popular expectations, the government failed to implement a consistent and effective technical policy.

The state intervened a second time during the years of rapid economic

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growth. Between 1956 and 1973 the economy experienced a major boom interrupted only briefly by the recession of 1964-65. The first burst of sustained growth (1956-1964) was led by the rapid take-off of the basic processing industries, primarily steel and petrochemicals, which was made possible by imported technology. The development of heavy industry was spurred by a sense of crisis brought on by foreign pressures to liberalize trade. The second wave of expansion (1966-1973), was sustained by extending and streamlining Japan's heavy industrial base. Western insistence that the country allow the entry of foreign capital again served as an effective prod to action. During the period of accelerated growth, the state intervened actively, placing science and technology at the service of an expanding economy. Catching up with and matching the West's industrial performance became a national goal. The centralized administrative apparatus required to support technological progress was put in place and consolidated at this time.

The 1973 oil crisis brought an end to the high growth rates and unbridled optimism of the 1950s and 1960s. As political and military tensions in the world heightened, considerations of "economic security" and national defense began to colour the thinking of government planners and business leaders with respect to technology. During the 1960s, technical innovation was promoted in order to hone the competitive edge of Japanese exports, but by the late 1970s, the government had begun to turn its attention to shaping a comprehensive technoscientific system. The new technical order would enable the state to pursue both economic and politico-military objectives deemed in the national interest. The primacy that has been accorded to the concept of the technology-oriented society since the early 1980s suggests that Japan is now moving toward some form of military-industrial complex. This development marks a historic rupture with the postwar era and sets the country on a new and uncertain course.

In February 1958, twenty-six years ago, the fledgling Science and Technology Agency, established two years earlier, issued its first White Paper. The report was subtitled, "From Foreign Dependence Toward Self-Reliant Development." The late 1950s were boom years for Japan, which had just entered its first phase of sustained economic expansion. Yet reading the White Paper, one is struck by the surprisingly small scale of scientific activity in Japan. In 1956, a mere ¥47.5 billion were earmarked for scientific research, and there were only 35,000 researchers in the country. According to the latest White Paper, released at end of 1982, ¥4.7 trillion were spent on research and development in 1980, and 317,000 scientists were engaged in research. In the past 25 years, then, R&D expenditures have expanded by a factor of 100, and the number of research personnel has grown tenfold.²

What concerns us here is not the spectacular expansion of scientific research over the past quarter of a century but the 1958 White Paper's emphasis on technology's contribution to economic growth and the need to choose the path of self-reliant technical development:

The progress of Japanese technology remains dependent on

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foreign technology . . . The greatest problem facing national technology is that of freeing itself as soon as possible from foreign tutelage and following a path of self-reliant development. Research, from which technical progress flows, holds the key to attaining this goal . . . The fact that today Japan is not, as it should be, an exporter of technology is an inescapable consequence of this dependence. The greater part of human and financial resources have been allocated to research projects designed to speed the absorption of imported technology. This emphasis has discouraged technical innovation. More important, the introduction of foreign technology has robbed managers and researchers of the incentive to innovate, causing basic research to stagnate. The introduction of foreign technology has had a negative effect on national research activities whose primary objective is to foster the development of an independent technological base.³

Two things are striking about this passage. First, the basic outlook of those who formulate national research and development policy has changed little in the past 26 years. Today, as in 1958, government planners and policy makers are urging an independent course of technical development tailored to the needs of economic expansion. Second, instead of the sense of urgency that informs technical policy planning today, one finds in the 1958 report a bland optimism: Untroubled by outside pressures, the authors of the White Paper are not very clear about why Japan should develop an independent technical base. In the late 1950s, the Japanese economy was still ensconced behind a thick protectionist wall, and the advanced technical infrastructure that would support later growth was just then being developed. The panic aroused by American pressures to liberalize trade was a few years off. The notion of breaking away from overseas dependence was seen as a progressive idea whose time had come, not as a matter of urgent necessity.

The first science and technology White Paper holds another surprise. Citing the link between technology and military expansion in the postwar world, Japanese planners decisively reject the use of technology for defense purposes, underlining instead its purely economic applications:

The advance of science and technology is opening up new possibilities in every field of industry throughout the world. In recent years, North America and Western Europe have diverted a significant proportion of their national resources to technical development, budgeting massive funds for education and research. The primary motive behind this effort, however, lies in the rivalry that exists between the Free World and the Socialist Bloc. The leading foreign powers are developing science and technology for defense purposes; technical

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progress in other fields is a secondary concern. As a result, the overall development of science and technology in these countries tends to be circuitous and lacking in coordination. Instead of following their example, Japan (should) choose a road to peaceful, independent development in order to assure national prosperity and raise the living standards of its citizens. Should Japan devote its energies to achieving the technical progress required to attain this goal, the results will be well worth waiting for.⁴

Japan did not break entirely with the Western model of military-led technical innovation, but its decision to adapt technology to economic ends put it substantially behind in military technology and closely related fields, such as aerospace development. However, in other areas, Japan soon caught up with and, in the application of technology to industrial production, often surpassed the West. The prophecy of 1958 has been fulfilled.

Crisis Consciousness

In the space of 25 years, Japan has been transformed from a staunch protectionist nation into a fervent advocate of free trade. Today, its exports are aggressively invading the world market, raising cries of alarm among its major trading partners and aggravating trade frictions. Yet success has not altered the outlook of Japanese businessmen and policy-makers; they have become even firmer in their determination to protect Japanese interests by increasing exports. At the root of this expansionist élan is the crisis mentality formed in the early 60s in response to foreign pressures to liberalize trade and capital. As Japan's vested interests have grown to enormous proportions, feelings of imminent doom have intensified instead of subsiding. In the domain of science and technology, this crisis consciousness finds its clearest expression in the concept of the technology-oriented state, which emerged fully formed in the early 1980's after a long metamorphosis.

The concept of state-led technical development is not new. The 1958 White Paper cited technology as "a vital component of national prosperity." This idea was not formulated as national policy in Japan until the late 1930s, but scientists had pointed to modern technology as a key factor in economic growth early in this century, urging government to use the considerable powers at its disposal to encourage scientific discovery and technical innovation. The *Draft Proposal for the Establishment of the Physical and Chemical Research Institute*, drawn up in 1915 by prominent scientists and engineers, provides important insight into this thinking:

Our country (is called upon) to establish at the earliest possible moment a physical and chemical research institute worthy of first-rate power in order to promote original research. This is necessary if every industrial field (in our country) is to develop

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and flourish. At the same time, Japan should develop its own research capability and power of invention in order to pay off the debts it has incurred by borrowing foreign knowledge. As we develop our capabilities, we may expect to make our own contribution to the progress of world culture and civilization... The Empire has already fought three great wars, enhancing its prestige and authority (in the world). However, if it is to maintain and multiply this power, the national budget will have to be enlarged substantially. Increasing the wealth of our nation and our ability to shoulder the burdens (of national development) is a fundamental problem of nation-building that requires prompt attention. But our country is small and its land base limited. To compensate for our lack of natural resources which limits the development of agriculture, mining, and other primary industries, national industrial policy must favour forms of production based on (specialized) knowledge. Physical and chemical research is the only source of this knowledge. The Physical and Chemical Research Institute is essential if we are to make full use of scientific research and its applications (in pursuing national development). Its establishment is an urgent requirement of the times.

Substituting science and technology for "production based on knowledge", and updating some of the language, we find set out in rather neat terms here the modern theory of the technology-oriented state.

Of special interest is the emphasis on promoting scientific development as a means of overcoming the limitations to growth imposed by Japan's lack of natural resources, its narrow land base, and its large population. For national planners the 1915 proposal is a fail-safe formula for eternal progress that justifies expansionism in any form. The only substantive difference between the ideas expressed in this document and contemporary thinking about technology is the scope given to military activity. In 1915, the term "first-rate power" reflected Japan's rise as a military nation and the creation of the Greater Japanese Empire in the wake of victories over China (1894-95) and Russia (1904-05). Today, Japan, boasting the world's second largest GNP, has substituted economic prowess for military might.

If the notion of technology-oriented national development is time-worn, its formulation, whether as state policy or ideology (ie: calls to improve the quality of scientific expertise), has always reflected specific national priorities. An early version of this concept found its way into government policy during World War I when scientists were recruited in large numbers to bolster the war effort. But this was only a temporary measure. The military potential of scientific and technical research was not fully appreciated in Japan or the West until the 1930s, when on the eve of World War II, states began to mobilize their respective scientific communities, now a vital asset, in preparation for war.

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The scientific establishment was enlisted in support of Japanese colonial policy after 1932, but the scale of colonial research remained small. The full-scale mobilization of science behind the war effort did not get under way until after 1939, following a major military setback. Between May and September of that year, a Soviet armored division defeated Japanese ground troops at Nomonhan in Outer Mongolia. Until then, scientific detachment had been regarded as somehow subversive and unpatriotic, reflecting the nationalistic temper of the times. This attitude changed overnight as the state itself stepped in to update and expand scientific research and explore its practical applications. Rapid technical progress became an important national goal and was codified in slogans such as "Consolidate a New Scientific and Technical Order! Build a National Security State!" The technological state became a clearly articulated national policy.⁵

The problem of recovery obliged science and technology to take a back seat in the immediate postwar years, and further systematization of technical policy was suspended as the wartime scientific establishment was dismantled. By the mid-1950s, however, the United States and most other industrial powers had set up the bureaucratic machinery for framing scientific and technical policy. Japan was not far behind. In May 1956, the Science and Technology Agency was inaugurated as part of the Prime Minister's Office, and in 1959, the Scientific and Technical Administration Commission, the nation's highest advisory body on scientific policy, was established.

Once again, the state took a direct hand in guiding the course of technoscientific development.⁶ In October 1960, the Scientific and Technical Administration Commission published the first programmatic statement on national science policy since the war, the *Comprehensive Basic Policy for the Promotion of Science and Technology in the Coming Decade*. Coinciding with then Prime Minister Ikeda Hayato's "income-doubling plan", the report stressed that technical planning should be geared to specific economic policies. The income-doubling scheme called for the laying down of an advanced industrial infrastructure and the rapid expansion of trade in a bid to double Japan's national income in the decade between 1961 and 1970. To achieve these results, it was proposed that two percent of the national income be allotted to research and development over the 10-year period. The plan deemed that Japan's 170,000 scientists and engineers were insufficient to meet its goals and recommended that the number of students enrolled in engineering and technical courses be expanded. The Scientific and Technical Administrative Commission's report, plainly drafted with the Ikeda plan in mind, made virtually the same recommendations.

Technical Policy and Economic Planning

The close relationship that developed between technical policy making and economic planning in postwar Japan is conspicuously absent in North America and Western Europe. This is not surprising in view of the development of technology for military purposes by Western governments. In the postwar years,

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the greater part of R&D expenditures have been paid for out of national coffers, and well over half of these funds have gone for military-related research, an accepted fact of life. In other words, assuming the above estimate to have some basis in reality, at least one quarter of the money budgeted for scientific and technical research in these countries has been channeled into military R&D.⁷

Some readers will object that the very approximate figure of 25 percent is exaggerated, others will say it is too conservative, but both arguments beg the question. The essential point is that military research is the compelling force that has brought science and technology in general to a high level of sophistication. The impact of defense-related research on the evolution of postwar technology has been far greater than the actual budgetary outlays for military R&D would lead one to expect. Without it, today's state-of-the-art technology would not exist, and the mode and thrust of techno-scientific development would be different.

Front-line technology in Japan is nearly identical in structure and function to the military-centered technology produced in the West: in this sense, it, too, bears the imprint of postwar military expansion. Technical know-how developed first in North America or Western Europe for defense purposes has been transferred routinely to Japan as the private sector has discovered industrial applications for it. Nevertheless, on balance, compared with the industrial West, Japanese technology has developed more in response to the demands of private industry and market forces than to defense requirements.

Western countries, though, have not been indifferent to the contribution of technology to economic growth. Focusing on Europe, French political scientist Jean-Jacques Salomon has identified two stages in the evolution of scientific and technical policy in the industrial states.⁸ During the formative phase, i.e.: from 1945 to the mid-1950s, most Western nations created the administrative structures necessary for promoting and sustaining rapid technical advance. The second stage, which Salomon dubs the pragmatic phase, is described as lasting from the mid-1950s to 1967. In the first half of the latter period, strategic concerns determined the pace and direction of technical progress, but during the second half, attention turned to the role of technology in boosting economic performance. As science came to be regarded as a crucial asset in enhancing the competitive power of domestic products internationally, pragmatic economic planners began to insist that national R&D expenditures be raised to three percent of GNP. The new appreciation of technology was stirred by the unprecedented expansion of the world economy in the mid-1960s, and toward the end of this period, priorities shifted. State investment in arms development was curtailed significantly, and more funds were diverted to R&D projects having practical applications for high-growth industries in the private sector.

Japan did not turn its back on the rest of the world during the 1960s. Technical development in the West continued to be tied to military strategy, but these countries were just as determined as Japan to tailor technology to the requirements of a high-growth economy. The era of accelerated expansion saw the emergence of comprehensive technical policies aimed at insuring progress

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in both military and industrial spheres. Japan alone, however, innovated exclusively to raise industrial productivity and corner a larger share of the world market for its finished goods.

Many Japanese look back on the era of economic prosperity as a time when the nation calmly set its sights on catching up with the West, rolled up its sleeves, and proceeded to do so. The idea is alluring especially to those of us who grew up in the years following the first oil crisis, *but it is a myth*. A sense of impending crisis generated by outside pressures compelled Japan to chose the path of industrial expansion. Throughout the 1960s, Japanese were captive to two nightmarish fears: the liberalization of trade and the opening of the domestic market to foreign investment.

Japan's mid-1950s policy of heavy industrial development based on imported technology succeeded spectacularly. But, as growth indices soared, foreign pressures mounted on Japan to remove protectionist barriers and free the economy from irrational, "feudal" restraints. Calls for trade liberalization reached fever pitch in the early 1960s, causing government and business circles to react with extreme alarm. The looming spectre of free trade was compared to the forcible opening of Japanese ports by the West in 1853. It was widely feared at the time that Japan, which had just laid the groundwork for heavy industry, would be quickly submerged by a torrent of cheaper Western products and driven out of business: the country would remain forever a producer of light industrial goods. The emphasis placed on developing an independent technical base in the 1961 income-doubling plan reflects the acuteness of this perception. But by 1963, trade liberalization had run its course: Japan's heavy industry remained intact.

By the middle of the decade, however, the West was pushing hard to open the Japanese market to foreign investment. Commodore Perry's black ships were once again sighted on the horizon. Big business warned that if the West got its way, domestic industry would come under the control of foreign capital. Capital was liberalized in five stages between 1967 and 1973. By the end of this period, the basic requisites for Japan's transition to a free-trade economy had been met.⁹

As Japan prepared to grant foreign capital entry to the domestic market, government and business leaders began to call in earnest for self-reliant technological development. The 1958 science and technology White Paper had sounded a similar note, but this time the slogan was being raised with genuine urgency. Ultimately, it was not technical self-reliance that enabled the economy to weather the crisis of capital decontrol but two unrelated factors: corporate mergers engineered by big business in its search for scale economies; and the thorough streamlining of production in the heavy industrial sector.

From the middle to the late 1960s, the clamour for a self-directed approach to technical innovation was accompanied by the implementation of a number of concrete measures designed to bring this about. A series of giant, futuristic R&D projects were started at this time. Nuclear power development was initiated after 1966, leading to rapid progress in applying basic research and readying nuclear

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energy for commercial use. In 1967, the Power Reactor and Nuclear Fuel Development Corporation was set up as a semi-private company under the Science and Technology Agency. Nuclear power development became a national priority. The aerospace industry also was developed at this time. The Space Development Commission was formed in 1968, followed in 1969 by the National Space Development Agency (NASDA). Until then, the University of Tokyo had directed aerospace research in Japan, but most of the work done there was limited to scientific experimentation and observation. Thereafter, the Science and Technology Agency assumed the lead in this field, taking a more practical approach to space technology.¹⁰

Large-scale pioneer technology, then, was developed rapidly after the late 1960s, largely in response to foreign insistence that Japan throw open its market. This period also witnessed the first unmistakable signs of a general disillusionment with science and technology. Curiously, however, the huge national projects were not singled out by the public for criticism. Instead, people took aim at industrial pollution and other forms of environmental disruption, technology-based ills that affected them in their daily lives. Technologies not associated with expanding scale economies in the basic processing industries escaped critical scrutiny: the end products of technical progress were attacked, not big technology itself. Under state tutelage, new large-scale projects made rapid strides.¹¹

Developing high technology involves two complementary processes. The first is the adaptation of tested innovations to production in order to achieve economies of scale and slash basic production costs. The second is the discovery of new practical uses for frontier technologies. As this often means looking for ways of increasing scale and making such innovations commercially viable, a sharp distinction cannot be drawn between the two aspects of development.

MITI

Throughout the years of industrial expansion, Japan's economic performance did not depend on a series of technical breakthroughs but on the constant improvement of existing technology borrowed from the West. The realization of scale economies remained the primary objective of innovation in the 1960s, but toward the end of the decade, Japan began to explore, in earnest, new scientific frontiers. In 1966, the Ministry of International Trade and Industry (MITI) set up inside its Agency of Industrial Science and Technology a program to plan and coordinate the development of large-scale industrial technology. The projects involved both the public and private sectors. In a 1971 report, the MITI broke new ground by calling for the priority development of knowledge-intensive industries. The document, *A Policies Vision of International Trade and Industrial in the 1970s*, marked a radical departure from previous policy, committed to promoting scale economies in the basic processing sector. It identified four types of knowledge-intensive industries and proposed the consolidation around this core of a "knowledge-intensive industrial base." These were: R&D-intensive

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industries (computers, aeronautics, nuclear power, robotics, integrated circuitry); modern assembly industries using advanced technology (communications machinery, office automation equipment, numerical-control machine tools); fashion industries (haute-couture, high-quality furniture); and knowledge industries (data processing, information services, consulting, computer software, systems engineering).

By the early 1970s the emergence of new front-line technologies developed after the late 1960s had produced a gradual shift away from large-scale heavy industry toward knowledge-intensive high technology. Although the oil embargo of 1973 put an end to the technical boom of the previous decade, the funds allocated to research and development continued to grow for some time afterwards, hastening the transition. The oil crisis also wrought a qualitative change in the very concept of technical innovation. During the 1960s, technical advance was spurred by the need to maintain the competitiveness of Japanese industry in the face of strong Western pressures to liberalize. Rapid economic growth was a national policy goal, and this challenge could be met best by allowing economic necessity to direct innovation. But after 1973, a new concern surfaced, one that continued industrial expansion could not dissipate: national security. The structure of postwar Japanese science and technology, closely attuned to the requirements of the economy and the private sector, began to change, moving closer to the military-industrial model of technical development prevalent in the West.

The Technology-Oriented State

The expression "technology-oriented state" first appears in a policy paper issued by the Scientific and Technical Administration Commission in May 1977 entitled, *Guidelines for a Comprehensive Scientific and Technical Policy in an Era of Resource Scarcity*. The term was not given a precise meaning, however, until the government of Prime Minister Ohira Masayoshi (1978-1980) mapped out its comprehensive national security strategy. Once into the 1980s, the concept gathered public momentum. The expression now appears regularly in official publications, public relations literature, and even in popular magazines and newspapers. Just as an earlier generation of academics attempted to link their work conceptually to the Pacific war, regardless of their legitimate research interests, so scholars today feel constrained to pay lip service if not homage to the idea. "Building a technology-oriented society" contains an emotional appeal that defies precise definition. It is easily the most effective, far-reaching technical-policy slogan of the postwar period. The 1980 White Paper on science and technology defines the technological state in these terms:

Our country lacks natural resources, such as oil, and its narrow land base is home to a large number of citizens. It is not an exaggeration to say that (if Japan is) to overcome the severe restrictions (that inhibit its growth) and maintain an average

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real growth rate of 5.5 percent per annum, technical innovations based on scientific and technical progress must be assigned a major role (in economic development) . . . In our efforts to achieve technical breakthroughs independently, technology must be strengthened by promoting basic science and creative human resources must be nurtured carefully. What is demanded of us in the 1980s is the creative development of an independent technology suited to the special features of Japan, a technology capable of generating economic growth and assuring international cooperation. At the same time, a "technology-oriented society" should be built to increase Japan's international bargaining power.¹²

The figure 5.5 percent, obviously unrealistic today, is derived from the *New Economic and Social Seven-Year Plan*, which was released by the Ohira government in 1979. Just as a decade ago, the basic premise remains that technical policy should reflect the objectives of economic planning. But an important nuance has crept into economic thinking itself: whereas the overriding consideration of policy makers in the 1960s was how to maintain Japan's competitive position internationally, today the key word is "economic security".

Economic security is an ambiguous term, but it seems to be used in two senses: maintaining security through economic growth and insuring the security of economic activity in general. Obviously, the size of GNP is not a sufficient guarantee of national security; economic growth must be accompanied by strong political and military policies. A 1982 report, *The Economic Security of Japan*, issued by MITI's Industrial Structure Council, is helpful here because it supplies us with concrete examples. The paper identifies three national priorities related to economic security: insuring a stable supply of crude oil and other critical raw materials; preserving and strengthening world-system functions; and creating a technology-oriented economy compatible with international obligations. All three objectives are eminently political, and each can be understood to imply some degree of military commitment. Although never defined explicitly, economic security may be thought of as identical with Ohira's concept of comprehensive security: the two-track pursuit of economic and strategic goals.

The 1982 MITI paper introduces another political concept: bargaining power, which is described as an attribute of the technology-oriented state. Like economic security, the term is employed loosely, but it appears to mean two things: bargaining power with respect to the industrial West, and bargaining power *over* countries of the third world.

In the postwar world, technology became a commodity that was bought and sold like any other merchandise. The 1958 White Paper referred frequently to the "commercialization" of technology, an important factor in Japan's formula for economic growth. Japan was able to overtake the economies of the industrial West by acquiring innovations sold openly on the world market. But today we

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have entered the age of technological security. State-of-the-art high tech is no longer sold over the counter to any bidder. It can only be obtained in exchange for equally sophisticated hardware or software. To Japan, whose commercial success rests on copying and improving Western know-how, this is a sobering thought. It explains why government and big business are pulling out all the stops to develop an independent technical capability, displaying a determination that was absent in the late 1960s. Simply put, "bargaining power" means the ability to destroy the technological-security shield the West has raised to Japan by capturing the lead in high technology. At the same time, MITI seems to be suggesting that technical advances linked to the modernization of mining, agriculture, and manufacturing be used to strengthen Japan's position with respect to the third world.

The idea of technology as a bargaining tool appeared shortly after the oil crisis as government thinking turned to ways of protecting Japan's access to raw materials. Until the late 1970s, however, when this concept re-emerged alongside that of the technology-oriented state, it was expected that technical progress would solve the energy crisis and lessen Japan's dependence on foreign natural resources. The years between 1973 and the end of the decade define a period of transition. During this time, debate over Japan's technical policy, which centered around nuclear power and alternative energy sources, seemed strangely devoid of substance. The media entertained the idea that technical innovation was dead and speculated that no revolutionary breakthrough was coming. They had a point: the pioneer technologies of the late 1960s had not yet matured: innovation did indeed appear to be at a standstill.

However, in the early 1980s, the technical impasse was broken. Almost simultaneously, the theory of the technology-oriented state emerged, with its implicit emphasis on the potential contributions of technology to national security. In retrospect, the late 1970s, ostensibly a technical void, appears as a critical gestation period during which the ideological foundations of technological nationalism were laid. Without this rupture in continuity the transition from the high-growth economy of the late 1960s to the high-tech economy of the 1980s would most likely have proceeded unnoticed perhaps robbing the theory of the "technological society" of its rhetorical force.

A Military Technology Gap?

In late 1982, Nakasone Yasuhiro replaced Suzuki Zenko as prime minister. Soon after taking office, the new government announced a major change in national policy on technology. Japan, Nakasone said, stood ready to provide the United States with the full panoply of Japanese military technology in times of war or peace. Although the new policy made no provision for exporting weapons, now prohibited by administrative policy, it left open the possibility of arms exports at some future time. But supposing Japan chooses this path: is it realistic to imagine that the country can someday rival the United States in armaments production?

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Some business leaders boast that with adequate funding, Japan is now capable of developing and producing any weapon available in the arsenals of the West. Specialists, regardless of their political convictions, also tend to agree that Japan has the potential to become a major producer of advanced military technology. The right-wing critic Miyazaki Masahiro, in his book *The War of the Military Robots*¹³ claims that in the near future, Japan will have the capability to produce strategic weapons, including aircraft carriers, inter-continental ballistic missiles, cruise missiles, theatre nuclear weapons, nuclear submarines, strategic bombers, neutron bombs, space cruisers, and spy satellites. "Japan's front-line industrial technology", Miyazaki writes, "can be converted into equally advanced military technology at any time . . . As long as the (political) will exists to turn advanced private-sector technology to military use, Japan can become a great military power in very short order, just as the West is insisting that it do. Moreover, this transition could be managed smoothly and very cheaply."

When individual weaponry (eg. missiles) is considered, the technical performance of Japanese armaments and military equipment compares favourably with those produced anywhere.¹⁴ Japan is already one of a handful of countries manufacturing high-quality conventional arms. Much is made of the overwhelming advantage the United States enjoys in the field of military technology (and aerospace development). However, less than 25 years ago, it was being seriously argued that Japan was doomed to remain a light industrial economy. Almost overnight, it caught up in most fields and is now outpacing its Western trade partners in basic commodity production. But while the technology gap should not be exaggerated, producing superior weaponry is not the same as producing better automobiles or computers.

Commercial viability is the premise on which automobile and computer technology has been developed. Since R&D expenditures are normally recovered through profits government support is not required and the private sector can be counted on to provide adequate funding for innovation. The state limits public intervention to selective protectionist measures and special incentive or subsidy programs. A very different set of factors govern the growth and financing of defense industries. No internal dynamic, such as bottom-line considerations of profit and loss, directs the course of technical progress in this case. The government must assume full financial responsibility for insuring the growth and reproduction on an expanded scale of defense-related technology. That is why a military-industrial complex is indispensable for the rapid development of military technology.

Japanese technical progress in defense-related fields is still dependent on U.S. technology; only a political decision can free it from this tutelage. But one can already observe in Japan a convergence between civilian and military technical development, particularly in fields such as electronics where significant advances in both defense and industrial technology are just a matter of time. Today it is not uncommon for private industrial technology to be diverted to arms production and other military fields upon reaching maturity. The fact that the ability of Japanese engineers to design and produce any weapon given

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sufficient funding no longer depends completely on U.S. arms technology reflects the increasing overlap between military and non-military technology. Japan will not overtake the United States in advanced military technology with the same ease it has conquered the automobile and computer industries, but it would be a mistake to underestimate the latent military potential of sophisticated private-sector technology.

Some statistics will give us a better idea how far Japan has come along the road to militarization, and how far it still has to go. In 1982, Japanese spending on military R&D accounted for 1.4 percent of defense allocations and 2.5 percent of the total R&D. U.S. military expenditures for the same year came to just under 10 percent of the defense budget and more than 50 percent of the R&D funds were budgeted for military-related activities.¹⁶

The United States spends more of its national budget on military research than any of the Western countries. But a comparison of defense-linked research funds reveals a particularly large gap in spending between most Western nations, on the one hand, and West Germany and Japan, with the smallest military budgets of all, on the other. In 1961, the United States spent 71 percent of its R&D outlays on military projects, the United Kingdom 65 percent, France 44 percent, West Germany 22 percent, and Japan a mere 4 percent.

The low level of spending on military research in West Germany and Japan reflects the special historical conditions that obtained in these countries from 1945 until the late 1970s. During this period, the victors of World War II assumed the task of defending the defeated powers. As a result, a strong NATO force outfitted with nuclear weapons remains stationed in West Germany today, and Japan is still host to a large number of U.S. military bases under the Japan-U.S. Mutual Security Treaty. Enjoying a position of unquestioned superiority, the U.S. armed forces have shouldered the greatest part of this burden, and their presence has limited the expansion of independent military power and retarded the development of military technology in both Japan and West Germany.

The current round of U.S.-Japanese summitry and statements by the leaders of both countries indicate that the historical specificity of Japan's postwar science and technology is eroding rapidly. The Reagan administration has elevated Japan to the same status as America's West European military allies, even suggesting that its war-renouncing constitution be revised. But more important than outside pressures is the fact that the Nakasone Cabinet itself intends to bring down the curtain on the postwar era. Some critics accuse Nakasone of being a pawn of the United States. Be that as it may, if Nakasone makes good on his promise to transform the postwar system of science and technology, his administration will leave its mark on history.

In 1945, as a 35-year-old Diet member from the Progressive Party, Nakasone earned a reputation for himself when he unexpectedly introduced a bill in parliament to appropriate funds for the construction of nuclear reactors. His maverick intervention launched Japan on the path of nuclear-power development. Again in 1959, as director of the Science and Technology Agency, his first cabinet post, Nakasone set up within the Agency's planning bureau a preparatory

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committee to promote the development of space technology. This was the first in a series of moves that eventually resulted in the transfer of leadership of the aerospace program from Tokyo University to the Science and Technology Agency. On these and many other occasions, Nakasone has proved himself an energetic innovator in the formulation of technical policy. He is entirely capable of doing the unexpected and announcing a slate of radical changes designed to overhaul and expand Japan's defense technology program.

The Nakasone Cabinet has been consistently hawkish on defense issues, but compared to other world leaders, the Japanese prime minister is something less than an archmilitarist. However, his government intends to assume its "fair share" of military responsibilities as a member of the Free World alongside North America and Western Europe. Unless it abandons this line, military expansion is inevitable. Military growth, absorbing technical development, may be expected to proceed at high pitch, bringing Japan up to a level of defense readiness considered reasonable by other industrial nations.

But what is "reasonable"? Acquiring a defense establishment commensurate with its economic power would make Japan a military superpower second only to the United States and the Soviet Union. This is exactly what Japan's technocrats have in mind when they speak of ending the era of postwar science and technology. In the four decades since the end of World War II, Japan alone has been able to avoid militarizing its technology. This privileged position is the product of a specific historical situation, and it is not realistic to imagine that it can be defended indefinitely. In fact, there is a very real danger that Japan will someday rival the standards of military technology attained in the West: in which case, it is also likely to internalize the dynamic of military-industrial expansion that propels the economies of the other industrial countries.

The version of techno-nationalism being pushed today obscures these points. Instead, it emphasizes "economic growth", "bargaining power", and — although rarely defined clearly — "crisis management" (one of the legacies of the oil crisis). Yet the concept of comprehensive security has obvious military implications. The total exclusion of this dimension from public discussion of the technology-oriented society, itself one of the corner-stones of the government's comprehensive security scheme, is bizarre: One of the basic tenets of greater state involvement in technical development is left unexamined. Military R&D is an accepted fact of life to Japanese industrialists, but in the universities and intellectual circles, open discussion of this fact is taboo. This prescription is also deeply rooted in the public consciousness. Only in this context can the silence that surrounds the issues of substance raised by techno-nationalism be understood.¹⁷

Structural Recession/Militarizing Technology

The changes that have occurred in technical policy since the era of rapid economic growth seem to point in one direction. Japan is moving from a society in which the primary motif was purely economic to one increasingly dominated

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by the national security interests of the state. At the same time, Japan's "unreasonable" stance on defense is being abandoned in favour of policies more in line with the shared assumptions of other advanced nations. Today, as the sun sets on the age of Pax Americana, Japan's position in the U.S.-Japan military alliance is being reinforced amid emerging new international power relations. Given the shift in Japan's defense posture, the subordination of technology to national security requirements cannot, unfortunately, be dismissed as idle speculation. It is true that appropriations for military research remain modest, and Japan still has a long way to go before the military technology gap separating it from the Western powers is eliminated. However, when that gap is closed, or when Japan marshalls its resources and moves to close it, we will have entered a new era, one in which the strategic interests of the state direct the evolution of technical development.

Military expansion is said to impede economic growth. Stepping up defense spending may boost economic activity in the short run, the theory goes, but over a longer period of time, military production siphons off limited resources that would normally be allocated to meet private sector demand. This stifles productive investment and induces recession. Although some empirical evidence exists to support this contention, attempts to demonstrate a causal relationship between world recession and militarization are not convincing. The frenzied expansion of arms production after the Second World War, for instance, occurred amid an unprecedented worldwide economic boom. military expansion must be seen as just one of many factors influencing the pace of industrial growth.

Nonetheless, arguments opposing militarization in favour of arms reduction as a way of boosting economic growth continue to find a willing audience in Japan where this idea couched in sober academic language is advanced to explain Japan's postwar economic success. However, it was not the remarkable expansion of the economy that restrained military expansion, although there was indeed a trade-off between industrial growth and militarization. Japan owes its impressive growth rate to U.S. political pressure and the Japan-U.S. Security Treaty, which imposed strict limits on the size of the military establishment and kept defense spending to a minimum. This special relationship prevented Japanese corporations from investing substantially in weapons development and production. At the same time, however, it is difficult to imagine the business world uniting under the banner of disarmament. Today military production is viewed as providing a way out of structural recession most industrialists will not hesitate to jump on the bandwagon.

The argument that sustained industrial growth is incompatible with armaments production is flawed on another point: the uncritical assumption that economic progress is desirable in itself. It overlooks the fact that Japan's bloated economy now produces 10 percent of the world's goods and services, as measured by GNP; that in its rise as an economic superpower, Japan has acquired huge vested interests; that the strategy of comprehensive security with its implied use of military force has become an indispensable requisite for further

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industrial expansion. Given the ballooning of interests that need protecting and the restructuring of the political and military framework within which postwar economic growth has taken place, it is entirely unrealistic to suppose that Japan can continue to rely on its ability to maintain a competitive position in the world market by economic means alone. Unless Japan sheds its "economic animal" mentality and disabuses itself of the illusion that industrial growth is inherently good, it will not be possible to refute the technology-oriented state.

Superstate Japan

Driven by a sense of crisis, the Japanese have displayed amazing single-mindedness and sense of purpose in devising solutions to the complex economic problems of the postwar period. But, paradoxically, successfully clearing one hurdle after another — the liberalization of trade and capital, the oil embargo, and overcoming protectionism in trade and technology — has imprisoned them in a crisis mentality. This mind-set provides the energy that fuels industrial expansionism. When Japan was a relatively backward country trying to catch up with the West, the world could turn a blind eye to expansionism. When the world economy was still in full swing, Japan could be forgiven for taking a slightly larger piece of the pie. But this best of all possible worlds came to an abrupt end with the 1973 crisis. Capitalizing on its rapid recovery from the oil "shock", Japan has improved the competitiveness of its industrial products, outperforming North America and Western Europe. The subsequent export drive got underway just as the world economy receded deeply into stagnation. In recessionary times such behaviour is seen by other countries as overbearing and aggressive and led to threats of retaliation.

Pleading resource poverty, a small national territory, and a large population does not justify naked expansionism. A case can be made for Japan's overseas advance and its flooding of world markets with cheap industrial goods on the grounds of economic survival, but only as long as Japan's standard of living is comparable with other industrial countries. Today, Japan has far surpassed that level. In an age of worldwide poverty and hunger, nothing can excuse its monopolization of world resources. The glaring injustice of a country that has only 2.5 percent of the world's population yet produces 10 percent of its GNP is evident to all. Even if it reduced its economic activities by half, Japan would still occupy a privileged position internationally. But the expansionism of the strong knows no limits. That this thrust really hides a deep-seated fear of economic collapse only makes matters worse. It is this kind of thinking that produced the comprehensive security strategy and that now motivates calls for the building of a technology-oriented society. Given the influence Japan already wields in the world, techno-nationalism not only betrays the arrogance of power; it is dangerous. In exposing and refuting the logic of the technology-oriented state, it will not be enough to point to the probable consequences of this project. While the public must be alerted to the dangers of militarizing technology, so long as

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the expansionist ideology of the powerful, fed by the fear of economic ruin, is not debunked and abandoned, the state will move to protect its vested interests, sweeping all criticism aside. What is required is a basic rethinking of the premises of Superstate Japan as it nears the end of its postwar adolescence. This essay has attempted to situate the rise of the technology-oriented state in the context of the postwar development of Japanese science and technology. As the outlines of the new technical order become clearer, a deeper understanding of what state-led, technology-oriented national development means for Japan, its Asian neighbours, and the world will become absolutely essential. This is a collective task that will require the efforts of many minds.

Notes

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1. "Turning-point" is a convenient phrase whose imprecision encourages abuse. At worst it is an empty rhetorical device used to dignify the titles of scholarly works by giving them a vaguely progressive allure. Even researchers who employ the term with care are apt to give it a subjective twist, intending some nuance of social progress. Few writers who really believed society was entering a period of decadence would characterise the present period as a turning point. The uncritical use of this concept robs it of explanatory power, obscures the dynamics of social change, and makes it difficult to identify historical turning points when they actually appear, particularly where the transition is in a direction judged socially undesirable.
2. In current terms, the ¥47.4 billion spent on research and development in 1956 is a mere drop in the bucket. In 1982, ¥52.3 billion were budgeted for nuclear fusion research alone.
3. *White Paper on Science and Technology in Japan — From Foreign Dependence Toward Self-Reliant Development* (in Japanese), FY1958, pp. 32-33.
4. *Ibid.*, p. 46.
5. In discussing the role to be played by the new scientific and technical order, the accent was invariably placed on its military importance, and this was as true in the West as in Japan. See HIROSHIGE Tetsu, *A Social History of Science (Kagaku no shakai-shi)*, Chuo Koron-Sha, 1973.
6. Hiroshige has referred to this as the "capture of science by the Establishment" (*kagaku no taiseika*), *ibid.*
7. In other words, one out of every four researchers is involved in military-related work. If all scientists who have engaged in such research at least once in their career are considered, then the overwhelming majority have contributed in some way to military expansion. No other profession is so closely tied to the military establishment.
8. Jean-Jacques Salomon, "Science Policy Studies and the Development of Science Policy", in I. Spiegel-Rösing and D. de S. Price (eds.), *Science, Technology and Society: A Cross-Disciplinary Perspective*, Sage Publications, 1977, pp. 43-70.
9. In just 10 years, Japan changed from a staunch protectionist into an advocate of free trade, a switch that has embroiled it in heated controversies with its major trade partners. The Japanese case is a paradigm of just how extreme what Marxists refer to as capitalism's uneven development can become.

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10. See the author's "National Space Technology: The First 30 Years" (*Kokosan supeisutekuronorjii — sabjyussai no sugao*), in *Diamond Popular Science*, April, 1983.
11. An exception is nuclear energy, which, like the heavy and chemical industries, seeks economies of scale. Since the mid-1970's, nuclear-power development has become a major social problem. It remains one of the most crucial challenges facing modern science and technology.
12. *White Paper on Science and Technology in Japan — International Comparisons and Future Tasks* (in Japanese), FY1980, p. 116.
13. Miyazaki, Masahiro, *The War of the Military Robots (Gunji robotto senso)*, Daiyamondo-sha, 1982, pp. 6-7.
14. There is of course a difference between developing a weapon that works and developing one that meets the highest world standards of performance.
15. The usual procedure in acquiring rocketry and other aerospace technology is purchase, followed by production under license, and, finally, independent development. But in Japan, production under license and domestic production are still thought of as equivalent, attesting to the low technical standards of Japanese space technology.
16. Defense expenditures for 1982 were ¥1,398 billion, and military R&D expenditures came to ¥35.6 billion. The U.S. defense budget was \$214 billion, its R&D budget \$37 billion, and the military R&D budget \$20 billion.
17. However, the Nakasone administration may go out of its way to challenge this taboo. Its self-proclaimed role is to break away from and bring an end to the postwar era of science and technology, an objective that has been promoted in installments by preceding administrations.