FROM KIMCHI TO CONCRETE
The North Korean Experiment

If kimchi is made tasty and sold at a low price, who will go to the trouble of lugging around heavy earthenware jars to pickle vegetables? Dried radish slices, red pepper leaves, sesame leaves and so forth should also be processed well; more tasty bean paste and hot bean paste should be made and sold in greater quantities. This will make our life much easier and facilitate the apartment-style living.

At present we raise tens of thousands of ducks on our stock farms. Therefore, we should pay deep attention to the processing of duck.

KIM IL SUNG

Large-scale hydroelectric, earthmoving, concrete-pouring, and other projects that transform both nature and society; daring achievements of proletarian heroes against all odds, including internal and external enemies as identified by vanguard communists; mass, forced migrations of peasants together with other elements mistrusted because of outmoded worldview; extraction of investment capital from the countryside to build up heavy industry but inadequate support for social overhead capital, schools, stores, and housing; manifestations of pseudoscientific tendencies under the pressure of ideology—all of these things describe some of the most disturbing aspects of the Stalin period in the USSR. Do they not also describe the Democratic People’s Republic of Korea under Kim Il Sung and Kim Jong Il? Kim Il Sung would say that North Korean development focused not just on heavy industry, but on light industry as well, and especially on the quality of life of the worker and peasant, providing them with kimchi, bean paste, and ducks and building a modern socialist society.

In the mid-1950s Kim Il Sung seemed poised to pursue industrialization and collectivization of agriculture while also devoting attention and resources to the consumer sector. Nikita Khrushchev provided an example. Khrushchev had
abandoned the Stalinist program of unrelenting investment in heavy industry and incessant exhortation to fight internal and external enemies. He began to empty the gulag labor camps, simultaneously ordering “rehabilitations” (many of them posthumous) for the victims of the Stalinist terror. Of course, Khrushchev maintained the unassailable position of the Communist Party, of planners’ preferences and the centrally planned economy, and while reining in the secret police he had no intention of disbanding the KGB.

In his speeches and programs of the 1950s, Kim Il Sung indicated a certain affinity with the Soviet approach. He spoke of the importance of rebuilding houses destroyed during the Korean War, providing clothing and other basic necessities to the people while simultaneously building industry and mechanizing agriculture. North Korea joined COMECON, the Council for Mutual Economic Assistance established by Stalin in 1949 as an alternative of sorts to the Marshall Program to rebuild Western Europe. North Korea entered the international scientific arena, sending dozens of novice nuclear scientists to the Joint Institute for Nuclear Research, in Dubna, Russia, beginning in 1956 for training and, with technology provided by the USSR, bringing on line its first experimental reactor at Yongbyon in 1963 for peaceful purposes. Initially foregoing autarky, Kim Il Sung declared, “We should introduce all the technology superior to ours, regardless of the country it comes from.”

Yet by the 1960s, Kim Il Sung and the Korean Workers’ Party had embarked on a policy of self-help and autarky under the banner of “Juche” ideology that led to virtual isolation. Kim Il Sung identified renegades within the party, attacked those who hoped for more balanced economic growth, and even rejected Soviet guidance and assistance in a number of spheres. He wearied of Soviet heavy-handedness in COMECON, through which Moscow insisted on providing finished goods to North Korea at terms that were not always favorable in exchange for raw materials. Regarding Juche, Kim Il Sung said, “We formulated our policies independently by creatively applying the Marxist-Leninist principles to the specific realities of Korea and enlisted the inexhaustible creative potentials of our industrious and talented people and the rich domestic natural resources in the carrying out of the policies.” He meant to go it alone and build a new kind of socialism.

With the Korean Peninsula we face the risk, as in the Soviet case, of claiming some kind of geographic determinism in shaping the face of technology. Recall how Trotsky believed that Russia’s backwardness had much to do with its vast spaces and difficult climate, and that only modern technology would bridge the
gap between countryside and city, not to mention protect the youthful proletarian republic against the advanced capitalist powers. The northern half of the Korean Peninsula is colder, more mountainous, and has richer deposits of mineral wealth, while roughly the southern half has a milder climate, more forest, and more arable land. The effort in the north to build industry and agriculture after the Korean War therefore was handicapped from the start by climate and resource distribution that favored industry but made agriculture costly and risky. Riverine water resources were limited by both total annual flow and great seasonal fluctuations. This led to the promulgation of large-scale national irrigation systems, stepped reservoirs along rivers, and hundreds of other impoundments to establish collectivized agriculture, while serving all important industry with water and hydroelectricity. But the headlong pursuit of Juche socialism through big technology resulted not from geography but from Kim Il Sung’s cult of personality that set a course of Stalinist, autarkic economic development.

Judging by the rhetoric of officials from the United States, North Korea was an evil regime. Its leaders sought weapons of mass destruction, starved its people, and threatened stability in the Far East. Isolated from the outside world, its closest allies, such as China, might only periodically exert a calming influence on it. So autarkic was North Korea that study of its political, economic, and social systems—and especially its strategic technologies—is possible only with great difficulty, and many of the conclusions that we draw must be based not only on limited information but also therefore on our own preconceptions. And yet sufficient material exists for an evaluation of the genesis and place of large-scale technological systems in North Korea. The Foreign Languages Publishing House in Pyongyang published scores and scores of editions of Kim Il Sung’s works, official party transcripts, and planning documents that enable this evaluation. These primary sources reveal the government’s abandonment of any pretense to develop consumer society (here, metaphorically, kimchi, a traditional dish of fermented and often spicy vegetables), a focus on big industry, and a hubristic belief in the ability of the masses of workers to transform nature under the proper guidance of the Korean Workers’ Party. In its autarkic economic development policies, in the genesis and diffusion of technology, in the formation of a cult of personality and cult of the Communist Party, and in its incessant ideological pronouncements, North Korea was the epitome of Stalinism. In its devotion to large-scale technology based on rudimentary systems and in its determination to pursue metallurgical, mining, chemical, and military industry, North Korea produced typically socialist technologies.
Stalinism and North Korea

Engineers and scientists in North Korea, laboring under difficult work conditions with significant resource constraints, denied regular access to the international scientific community, and trained within a closed political system, have produced Stalinist technologies, more Stalinist than those developed in the USSR under Joseph Stalin. Although Stalin died in 1953, remnants of his system and the kinds of thinking he promoted persisted, not only in the former USSR, where de-Stalinization that commenced under Khrushchev was only partly successful, not only in the hero cities of Eastern Europe, but especially in North Korea. Under Kim Il Sung (“Great Leader,” 1912–94) and Kim Jong Il, his son (“Dear Leader,” 1941–, a specialist in North Korean socialist realist art, literature, and especially film), the government pursued a strictly Stalinist program. This meant that, like the USSR in the 1930s and 1940s, the government introduced a centrally planned economy that emphasized the development of heavy industry at the expense of other sectors. Agriculture was violently collectivized. Owing to the absence of economic incentives to encourage performance, the government turned to both coercive measures and exhortations. This exhortation involved various campaigns and programs, some indigenous, some modeled on Soviet Stakhanovism, that is, highlighting the achievement of higher than planned norms of productivity for a worker or brigade of workers as an example for other workers to follow. Constantly invoking campaigns to increase industrial production and raising the specter of hostile encirclement by the United States, South Korea, and Japan, Great Leader and Dear Leader promoted autarkic economic, scientific, and engineering institutions.

Stalinist regimes produced technologies noteworthy for great scale that dwarfed human sensibilities and aesthetics. Economic imperatives led to the adoption of large-scale, resource-intensive, symbolically important, yet highly irrational projects. The power stations, transport and communications infrastructure, factories, and so on, reflected the tendency of the state to collect power in centrally controlled institutions and bureaucracies to administer factories, things, peoples, and technologies. The technologies served first of all state economic development programs and reflected planners’ preferences; hence, they were designed with insufficient attention to safety and environmental concerns, for example, various redundancies to protect the worker or filters to lessen pollution. Any regulation either served those industries to be regulated or was ignored.
In Stalinist regimes like North Korea, officials see nature as real, knowable, and important to the state; pre-socialist nature itself is capricious and mysterious, while Stalinist nature is rational and planned. The major tool to exert control over society and nature is the Communist Party, with its insistent vision of the future and its science and technology purged of bourgeois thinking and personnel. They are the bulwark against assault from dangerous, hated outsiders. They are symbols of national achievement and of the advantages of the socialist system over the capitalist one. While socialist technologies share this last feature—ideological significance—with capitalist ones, they are different in one important regard. Stalinist science and technology are decidedly transformationist, tools to change a backward, agrarian nation into a modern industrial power and to change the peasant, the religious middle class urbanite, and others into conscious materialist citizens.

Political desiderata reinforce these tendencies by preventing public input in the technology assessment process. A one-party regime insists on allegiance to its development programs. Engineers and scientists who question the pace, scale, or costs of those programs face hostile scrutiny or perhaps worse. A secret police with great power to surveil seeks to uncover dangers—both domestic and international—that threaten the regime, while absence of open media means that no engineers, let alone citizens, have channels to question the programs. This also leads to extra-scientific censorship of results and extensive ideological interference. State planning ensures dedication to state goals and emphasizes applied science at the expense of basic research. The resulting closed research and development (R and D) system restricts expert and citizen input into determination of safety and efficacy. Technology remains only a symbol of modernity and a panacea, never a potential danger.

What is an authoritarian regime? Beyond the monopoly on power usually manifest in one-party rule, a charismatic leader or tiny clique presides at the top of the party, with unquestioned and arbitrary personal power. Members of the ruling elite share a fiery commitment to transform society. One of the tools they use is a monistic belief system that encourages the individual to identify with state goals. This belief system, which includes mythical notions of right and wrong, justice and retribution, nationalism, fatherland and/or motherland, and love for the leader, is disseminated through centrally controlled media. The system appeals to instinct as opposed to reason, although claiming the latter. The state employs secret police who use terror, coercion, and violence to reach its aims. It alleges the presence of internal and external enemies to mobilize the
masses. Unlike such authoritarian systems as Nazi Germany or Peronist Argentina, Stalinist regimes have eliminated private property; the state in the name of the working class owns all property. Following the Soviet example, North Korean communists embraced centrally planned economies and a command approach to ensure resource allocation based on planners’, not consumers’, preferences. They pursued autarkic economic development. They employed various campaigns of exhortation and coercion to increase productivity of workers in the absence of material incentives.

In terms of technology, several features distinguish Stalinist and other authoritarian regimes from other systems. Tautologically the state is the prime mover in technological development. In order to achieve the goals of economic self-sufficiency and military might, the state harnesses the efforts of engineers and scientists to its programs. State officials, guided by heroic ideology, determine what areas merit study. In exchange for funding, experts are held accountable to produce results, and failure to meet targets may trigger personal reprisals. A highly centralized and bureaucratized system of funding and monitoring ensures accountability. Since the state is the prime mover, its projects acquire significant momentum that carries beyond the completion of the initial goal. Bureaucracies everywhere seem to take on a life of their own, becoming institutions in search of a mission. The large-scale technological systems themselves acquire nearly unstoppable momentum, moving ahead in spite of geological and technical obstacles, garnering vast armies of workers, and starving other projects of support. Even those intended to satisfy the public need for food and shelter acquire “gigantomania”: public housing, subway systems, and government buildings have a depersonalizing scale. Their “ideological skins” are thick, overpowering, and intimidating. The gigantic structures reflect the effort of officials and engineers alike publicly to demonstrate the strength, glory, and legitimacy of the regime, and as such they become symbols of the present and the future.5

The centralization of science policy in Stalinist regimes enables one institution or approach to gain unassailable power to define orthodoxy. Owing to this momentum, it is more difficult to derail economically unfeasible and environmentally dangerous projects than in pluralist regimes. Occasionally “quack” scientists such as Trofim Lysenko, whose rejection of modern genetics destroyed the nascent field in the USSR, and with it the careers and lives of many respected scholars, and in North Korea Ri Sung Gi, a talented organic chemist, gain authority over entire fields of research and with it resources and censorship powers.
Great Leader Rebuilds after the War

Korean communist leaders logically pursued the Stalinist development model of collectivization of agriculture and breakneck industrialization. The Soviet Army occupied the Korean Peninsula when the Japanese moved out after their defeat in World War II. The Japanese government had pushed industrialization in colonial Korea in the 1930s and 1940s to expand the industrial base of the country in preparation for its war in Asia and the Pacific. The northern parts of Korea were the focus of the effort because of rich ore and mineral deposits, as well as coal and hydroelectric potential to power the effort. The north had higher growth of industry in the late 1940s compared to the south, in part because 75 percent of heavy industry was located in the north. Direct Soviet guidance and Japanese detainees were crucial to the postwar reconstruction effort. Soviet Red Army leaders picked a young guerrilla leader, Kim Il Sung, to be the communist leader.

Kim Il Sung joined the communist movement in the 1930s and led a division of a Chinese-sponsored anti-Japanese army working against colonial occupation. He and his division escaped to Khabarovsk and Stalin’s protection at the beginning of World War II. Here, he and other Korean guerillas received training, and on returning to Korea in 1945, like Trotsky before him, he immediately set to the organization of a military force, the North Korean People’s Army, with Stalin providing armaments, tanks, trucks, and even jets. The communists established the Democratic People’s Republic of Korea in 1948 in the face of growing evidence that peaceful unification of the north and south would be impossible. In 1950 war broke out over efforts of the north to unite with the south under Kim’s army, with Soviet and Chinese support, and U.S. efforts to prevent the spread of communism (the “domino theory”), with British and even UN support.

When Japan withdrew after the war, more than 1,000 factories were nationalized under the communists. Some small-scale business activity was permitted, and the number of private manufacturers grew until the Korean War. Foreign experts contributed to industrialization. Over 400 Japanese engineers were detained in North Korea, and Soviet experts soon joined them in factories, mines, hospitals, planning offices, and other workplaces to teach industrial management. When Japanese engineers were finally repatriated, Soviet engineers filled their places. They conducted technical education to improve skills of workers in operation of machines. In some factories the number of specialists and skilled workers grew from one thirty-fifth to one-tenth of the labor force in a few years.
But all in all, the quality of production fell significantly even if output increased, and electrical power, coal, steel, and chemical fertilizer production ultimately fell before the war. This left communist leaders feeling vulnerable.

Kim Il Sung repeatedly stated the goals of the Korean Workers’ Party to eliminate colonial dependence, backwardness, and lopsidedness in industry and to develop heavy industry with light industry simultaneously, providing the machine tools to get at natural resources and process them. The rebuilding effort had begun to gather momentum when the Korean War broke out. U.S. bombers leveled Pyongyang and also strategic sites in the countryside. As late as May 1953, the Air Force set out to destroy irrigation dams in the north, releasing floods that wiped out roads, railroad tracks, and thousands of acres of rice fields. The Koreans quickly repaired the damage, but they had to reduce the water levels to prevent flooding in case of another attack, and this reduced the water available to the remaining rice crops. The bombers also destroyed the Soopoong Hydroelectric Power Station, later rebuilt and expanded by the late 1950s to have the greatest capacity of any Asian station. Unfortunately, the reservoir was rarely filled to capacity, and this limited output. The bombing also destroyed industry, fields, and educational, public health, and cultural facilities. Factory buildings, machinery, raw materials, and technical knowledge were destroyed. Elected American officials and military men even spoke of using hydrogen bombs against Korea. It was logical in this environment of war and threats for North Korea to rely on Soviet aid and to emulate the USSR in many ways (planning, party structure, the creation of an Academy of Sciences, and reform of the educational system). China also contributed directly to the post-war reconstruction through millions of man-hours to build and rebuild bridges, reservoirs, dikes, and the like.

The subsequent division of the country at the thirty-eighth parallel and the establishment of a demilitarized zone, of course, created grave obstacles to the overall political, economic, and cultural development of the Korean Peninsula, making it, in the words of communist leaders, “impossible to utilize rationally the rich resources of the northern and southern parts of our country in the production and construction and to use them in a unified way for the wellbeing of the entire people of North and South Korea.” For his entire rule, Kim Il Sung therefore sought to turn his state into a military machine ultimately to conquer the south, but more immediately to repel attacks from such “imperialist aggressors” as the United States. He pursued large-scale industrial, energy, public water works, and other projects both for strategic and economic reasons and as
monuments to his rule. Because of his unequivocal power and that of the Communist Party, no one was in a position to question the human and environmental costs of the projects.

In pursuit of these goals, North Korean specialists often turned to reverse engineering, although not entirely successfully, when they could not rely on extensive indigenous industry and trade. In one case, having been refused a license to build Soviet tractors, North Korean managers and engineers set up a factory on their own based on copies. They produced a prototype with great fanfare and only one problem—it went only backward; they quickly solved this minor detail. They copied electric locomotives (based on a Czech engine), trucks (based on old U.S. “Diamond T” trucks that made their way to Korea by way of lend-lease to the USSR during the war), and even sewing thread. When they imported or otherwise acquired new technologies, they preferred to import from the West rather than import old-fashioned machines and equipment from socialist countries.\textsuperscript{10}

The cold war tensions between the socialist camp and the capitalist work of course led to a determined effort to build up the metallurgical industry for steels, chemicals for fertilizers and artificial fabrics, building materials industry for cement, and machine building. Machine building, Kim Il Sung asserted, was at the core of heavy industry and “the basis for technical progress.” This sector of the economy had to supply electrical machines, mining equipment, farm machinery, vessels, processing machines, and spare parts.\textsuperscript{11} He noted, “Our revolution does not permit us to slow down the rate of growth of industrial production.” The nation had to overcome technological backwardness as a result of Japanese imperialism; they could advance no further on the basis of old technology.\textsuperscript{12}

Following the Soviet example, North Korea immediately ordered the collectivization of agriculture at the end of the war. Kim Il Sung praised the peasants for providing food during the war, plowing fields with oxen whose backs were camouflaged and sowing seeds at night to avoid bombing. But the collectivization effort was as brutal as Stalin’s campaign had been in 1929–34. Kim sought to attract peasants to the farms by providing seeds, fertilizers, and equipment. By the end of 1956, 80 percent of the land had been collectivized. The process ended in August 1958, with more than 13,300 cooperatives having been formed. All aspects of farming, from planting and harvest to retail services and marketing, ran through cooperatives under the control of local party committees. The government required self-sufficiency in production. This meant a life
of sacrifice among the peasantry to support the military and heavy industry, allowing mobilization of resources for a constant battle. Self-sufficiency of agriculture would occur through the state-sponsored transformation of nature.

De Rigueur Planning and Heavy Industry

The Stalinist system relied on central planning and planners’ preferences. The plan would, according to officials, overcome the irrationality inherent in capitalism, but North Korean economic irrationality had its own special flavor. Korea launched two one-year plans (1947, 1948), two two-year plans (1949, 1951), a three-year plan (1954–56), a five-year plan (1957–1961), and then moved to seven-year plans (the first in 1961), all based on rapid state investment in capital construction for big technology in industry, agriculture, construction, and transport, followed by smaller amounts and increments in scientific research, health, housing, and social overhead capital, and even a decline in education and culture. Long-term plans, they learned, were rational plans. In March 1958, while celebrating the early fulfillment of the five-year plan, Kim Il Sung said, “We have already experimented with a one-year plan, a two-year plan and a three-year plan, and today we are discussing our five-year plan and carrying it out.” A one-year plan envisaged small-scale short-term construction. But a five-year plan envisaged “magnificent, large-scale construction over a long period.”

Officials adopted the longer and longer plans to complete “socialist construction” and “socialist rehabilitation” of the nation after the war, with heavy industry gaining the lion’s share of investment. In words and documents, agriculture and the consumer sector would also be resurrected. The Three-Year Plan for Postwar Rehabilitation and Development of the National Economy (1954–56), adopted to reach 1949 production levels, reminded citizens, for example, that “machines do not provide food.” Unfortunately for planners, they were unable to count on rapid increases in production of electrical energy, the typical technological panacea in socialist regimes, because it remained to build large thermal power stations to be powered by plentiful coal or hydroelectric stations, both of which required years to come on line. “Rehabilitation and construction” of industry and the simultaneous attempt to build roads, bridges, reservoirs, and housing consumed immense resources and generated bottlenecks of supply, dearth of building materials, and labor shortages. In an April 1955 speech, Great Leader drew particular attention to the Anju irrigation project that envisaged the excavation of hundreds of kilometers of waterways including
tributaries. On top of this massive project, to reconstruct factories, railroads, and bridges, they needed to resurrect cement production and the timber industry. All this required the mobilization of manpower, which Kim Il Sung assured his audience was a simple matter of organization. For example, he claimed that if organized properly, the mobilization of raftsmen in rural areas for work in lumbering activities would not result in idle crop land due to labor shortages. 17

And what of capital, building materials, and so on? Where would the iron and steel, coal, machinery, chemical fertilizers, cement, and bricks all come from? At the Third Congress of the Workers’ Party of Korea in April 1956, Great Leader reported that the three-year plan had already been fulfilled in most targets areas, with great strides in rebuilding the economy, with industrial and consumer goods production nearing 1949 levels, with expansion of cultivated areas, and so on. 18 But there could be no rest. He called for further rapid growth of heavy industry as the basis of the socialist economy: metallurgy (the Songjin Steel Works, the Kim Chaek Iron Works), mining (for example, the Kapsan Copper Mine), machine tools, construction and transportation equipment (mining and drilling machines, cranes, concrete mixers, excavators, railway coaches, and locomotives), shipbuilding, electrical power production and electrical motors, and building materials. 19 More coal was needed to free up timber for construction and to serve such new, massive factories as the Hwanghae Iron Works served by the Chondong Mine. 20

In 1957, the party adopted a five-year plan “to complete the building of the foundations of socialism in our country.” In good socialist fashion North Korea fulfilled this plan in two and a half years. Kim Il Sung observed that “socialist relations of production came to hold undivided sway in the towns and countryside, and the base of heavy industry with light-industry as its core, and the base of light industry were laid.” 21 The emphasis, he insisted, was on heavy industry, not for the sake of heavy industry, but for the people. Still, the major achievements of the plan in electrical energy, coal, pig iron, steel, fertilizer, and machine building all indicated that heavy industry was the primary interest of party leaders. 22

To keep his people’s attention focused on the plan and not on their continued material deprivations, Kim Il Sung repeatedly—and understandably—reminded Koreans about the great losses they had experienced under Japanese colonial rule and during the Korean War. They had had a very hard life with a precipitous drop in their standard of living. They had lost most of their furniture and household goods, their clothes and homes. At the second Supreme People’s As-
assembly in September 1957, he repeated his frequent observation that “towns and farm villages had been reduced to heaps of ashes, all branches of the national economy had been totally destroyed, and the popular masses had been deprived of the basis of subsistence.” But with the successful completion of the five-year plan, he was ready in June 1958 to announce that from those ashes “the towns and villages . . . have been rebuilt with a new look, and the material and cultural life of the people has markedly improved.”

Soviet technical influence included scientific management that reflected Taylorist language and concepts. The North Koreans published hundreds of Russian-language books in translation to encourage scientific methods to establish norms of production. Yet in 1956, when North Korea announced that its three-year plan had been achieved, they embarked on a five-year plan (1957–61) that would reach production norms not through new management techniques but through various campaigns. These campaigns or competitions made up for lack of skilled engineers and workers, lack of materiel, and decreasing foreign aid. As a result, self-reliance became a key, along with scientific management techniques and ways to rationalize industrial organization.

Ultimately, in the early 1960s, a managerial reform succeeded. Kim Il Sung, as was his wont, visited the Taean Electrical Machinery Factory on December 6, 1961, to give “on-the-spot guidance.” He referred to Korea’s great industrial achievements, but the need to link planning, production leadership, and technical leadership “organically.” The resulting Taean Management System served as the basis of economic management of the economy into the twenty-first century. Great Leader had chosen to link management and technical expertise to increase production. This signified that the economy had recovered sufficiently from the Korean War to try a new approach. The new approach went beyond urging people to work harder or emphasizing self-reliance. In the Taean Management System the chief engineer would be subordinated to the factory manager in an effort to bridge the gulf between administrative and technical issues and put management on a scientific footing.

With the five-year plan for creation of heavy industry including machine tools successfully achieved, the party established more ambitious targets for the seven-year plan (1961–67): an “all-around technical reconstruction and cultural revolution.” No longer was transformation of the productive relations sufficient; “socialist industrialization” was required. All branches of the economy were to be equipped with modern technique. Reminiscent of Stalin’s Great Break that included rapid industrialization, Kim Il Sung called for increasing
outputs or production in electrical energy, coal, iron, steel, and electrical motors two and a half to three and a half times; generators nearly thirtyfold; turbines over 100 times; tractors to 17,000 units annually by 1967 or fivefold; and synthetic resins over 60 times (based, as seen below, on a scientifically feasible but industrially unproven yet party-endorsed process). Ten new major mines would open; this required the development of tunneling and drilling equipment, in which the North Koreans eventually excelled—they built hundreds of kilometers of tunnels deep underground and through mountains for irrigation, hydroelectric, transport, and military projects. But expanded mining operations required the manufacture of iron and concrete props, owing to a shortage of prop timber, and did little to put food on the worker’s or peasant’s table. Of course, establishment of a new prefabricated concrete parts industry with annual output of nearly 2 million cubic meters would follow.

Industrial development was the sine qua non of the North Korean (and of virtually all Stalinist) centralized command economies. State-owned industry was responsible for 90 percent of production. Prices, wages, trade, budget, and banking all fell under state control. Like its Soviet counterpart, Gosplan, the Korean State Planning Committee established all aspects of planning, from inputs to prices and outputs; planners’ preferences prevailed. Nearly all goods were distributed through state-operated or cooperative stores. Under communist leadership the nation transformed rapidly from an agrarian economy (fishing, forest products, and farming) to an industrial one. The North Korean economy grew faster than the South Korean one into the early 1960s by focusing on development of an independent economy, yet taking advantage of extensive aid from the USSR and East European nations. When Moscow cut aid to the country to punish it for a turn toward China, the leaders sharply curtailed their involvement in COMECON and embarked on an extensive foreign borrowing program to push modernization, even though they lacked sellable goods to pay off the loans, and the nation eventually defaulted on billions of dollars of loans. Even with a precipitous fall in the pace of growth, annual growth of output remained above 10 percent through the mid-1970s. Industry’s share of national output also was very high, at the expense of agriculture; today’s endemic famines are no accident. The second seven-year plan (1978–84) saw increases in output in electrical energy of 78 percent, in coal of 50 percent, in steel of 85 percent, and in cement of 78 percent. Mining and metallurgy have grown on the backs of workers.

The fulfillment of plans ahead of schedule is difficult to verify because of
the paucity of reliable statistics, but the North Korean economic achievements are remarkable given the state of the economy in 1935, 1945, or 1955. The extension of the first seven-year plan (1961–67) into a de facto ten-year plan completed in 1970 indicated the challenges Korea faced in rebuilding from war and transforming into a socialist economy, although in November 1970 Kim claimed that the nation was no longer “industrial-agricultural” but “socialist industrial.” Still, targets for electricity, steel, chemical fertilizers, cement, and textiles had not been reached. Annual new year’s messages set tones for policies and goals, especially for seven-year plans. Following the example of the USSR, which sought to encourage innovation in industry through exhortation, in 1983 Kim Il Sung called for “speeding up” the introduction of advances into production.

Socialist Specialists Produce Socialist Technology

The socialist polity thrives on a variety of class-based tensions. Leaders maintain that they inevitably move toward classless society. However, the experience in Stalinist USSR in the 1930s, the fraternal socialist states of East Central Europe in the late 1940s and 1950s, and the People’s Republic of China during the Cultural Revolution of the 1960s indicates constant mistrust of potential enemies of the working class both within and outside the country. Intellectuals, even those trained entirely within the socialist system of education, fell under scrutiny. Communist parties feared their potential independence and dissidence, their special expertise that gave them greater access to the policy process than other groups, and their belonging to such strongly international endeavors as science, technology, art, literature, and music. Dissidents and other critics of the polity and economy in the USSR, Eastern Europe, and China were likely to come from the intelligentsia; Andrei Sakharov and Fang Li Zhe represented precisely this danger to communist leaders. The show trials of experts in the USSR and East Central Europe and the expulsion of intellectuals to the countryside to learn from the peasants in China indicate the extent of fear of individuals who were essential to the future of their countries. While workers on the shop floor and peasants in the field might suggest new ways to organize labor and other innovations, the labors of scientists and engineers in research institutes and universities surely were crucial to technological advance. In North Korea, too, party leaders worried about the potential autonomy of intellectuals.

North Korean leaders have embraced science and technology strictly for their
utilitarian functions and used them to promote autarky and self-reliance through rational management of natural and technological resources. Japanese colonization delayed creation of modern universities and research institutes. Yet no sooner had the communists taken power than in September 1946 the Kim Il Sung State University opened. In education and the sciences, North Korean communists followed the Soviet model. Over the next few years the government established a series of commissions that considered how to develop science and technology in the country. In 1952, even during the Korean War, the government founded an Academy of Sciences. Like its Soviet counterpart, the Academy stressed the political reliability of its members. Its social science and humanities institutes, which focused on party history, Marxist philosophy, and other ideological concerns, fared better than institutes of science and engineering, which required extensive expenditures for equipment, chemicals, and so on. A State Committee for Science and Technology, also resembling a Soviet bureaucracy of the same name, followed in July 1962 to boost innovation in heavy industry. While a number of lucky young scientists studied at Moscow and Leningrad State Universities, and others at Chinese facilities, autarkic relations prevented thousands of deserving specialists from developing skills abroad. Party officials touted the establishment of universal education and the expansion of a study-while-work system with evening schools, correspondence courses, and factory and communist colleges.

In the 1950s and 1960s Korean leaders claimed that they had expanded their pool of “technicians and experts” from very few to hundreds of thousands, although the question of quality remained given the rapid transformation of individuals with rudimentary schooling into technical experts. In part they accomplished this by establishing compulsory six-year education in 1956 and extending it to tenth grade in 1958. As Kim Il Sung explained, “Far more cadres in science and technology should be trained and the general cultural level of all working people should be raised rapidly. That is why the state even envisages the introduction of compulsory junior middle school education . . . while further developing middle and higher-level technical education . . . Our educational work should be closely linked with production, and the keynote should be to arm the working people with advanced technology and scientific knowledge and train them to be competent socialist builders.”

Simultaneously, the government created a new system of technical education; during the five-year plan, more than 135,000 engineers, specialists, and technicians were trained. The government also introduced the “factory college” so
that workers could study while continuing to be engaged in production. Communist colleges were established in the capital of each province, which, according to the Central Committee, trained “a new type of intelligentsia from the workers [who] could closely link production and education, theory and practice.”\footnote{37} By the mid-1960s party officials claimed that the nation had 290,000 technicians and experts; this suggests overcounting or perhaps inclusion among “technicians” individuals who were test-tube washers, high school teachers, and others, and of course quantity does not imply quality.

During the founding years of the nation, Great Leader rhetorically adopted a Leninist attitude to specialists. Old-line intellectuals were to be “educated and revolutionized . . . to serve the people and display their talents and skills.” They would be “steeled in struggle and remolded into Red intellectuals.”\footnote{38} In a mirror image of the experience in the USSR and the East European socialist countries, many Korean revolutionaries apparently had a hostile attitude toward bourgeois experts, while many citizens apparently stood in awe of science and therefore did not trust themselves to take the lead in suggesting innovations. In a speech at a provincial party committee meeting in March of 1958, Kim Il Sung urged a careful approach to this situation. He urged an end to “narrow-minded attitudes” toward intellectuals. “The working class should look to the intellectuals for their knowledge and techniques, and the latter should look to the former for their revolutionary spirit, strong organization and immense fidelity to the Party, thus uniting and cooperating with each other in the struggle for communism.”\footnote{39} He called for a symbiotic working relationship between the intellectuals and the workers. This was needed because of disparate shortfalls in qualified persons and modern materials. At a January 1958 meeting of activists of the Ministry of Light Industry, he noted, “We were short of well-trained technical personnel and had no equipment, too.”\footnote{40} This meant that Kim Il Sung was aware of not only bottlenecks in the economy and lags in technology because of the ongoing effort to develop heavy industry, light industry, and agriculture simultaneously, but also shortfalls in the training of skilled and reliable experts.

Yet the experts alone could not provide the innovative impulse needed to advance the economy. Simple workers and peasants would be encouraged to contribute through a variety of campaigns. Kim Il Sung reminded his audiences that the country had “worked wonders by mobilizing the forces of all the people in our extensive building of local industries, the let-one-machine tool-make-machine tools movement, etc.” An ongoing technological revolution would succeed based on the drive of the Korean Workers’ Party and a movement of the
entire people. He urged everyone to participate “in this honorable and worthy revolutionary task.” He demanded doing away “with all of the mysteries shrouding technology” that arose from having long lived in a backward state. Kim pointed out that under socialism “mystery-mongering has been dealt heavy blows.” Unfortunately, the attitude that the people could contribute significantly to modern science and technology created a fertile ground for pseudoscience to develop. If Stalin could endorse the Lamarckian theories of a simple peasant, Trofim Lysenko, with great damage to the development of genetics in the USSR, then similar dangers existed in North Korea.

Kim Il Sung urged constant reeducation of the intellectuals, retraining them, keeping them actively involved, putting them into factories, all the while training new cadres. A bad tendency was “that of ignoring or underestimating science.” Kim Il Sung warned that “like the mystery-mongering, this, too, holds back our technological development. Machinery itself is a product of the development of science; the technical revolution is inconceivable without science.”

The solution was “strengthening the creative cooperation between the workers who operate the machines and the technicians who have scientific knowledge.” The workers could offer the “new and valuable” experiences of everyday work. They always “racked their brains” to produce more with less effort. However, given that they knew only the machines they themselves operated, and knew them experientially and not theoretically, how might their knowledge be incorporated broadly into production? Kim Il Sung concluded, “The technological revolution will go forward successfully only when the workers and technicians help each other and learn from each other, when experience and science go hand in hand. It is wrong for the workers to refuse the help of science on the pretext of opposing mysticism; it is just as wrong for technicians to get swelled heads, as if they alone were learned, and refuse to accept what is new from the experience of the workers.”

Officials frequently announced that the majority of old intellectuals had come over to the people. Yet in practice North Korean officials adopted a hard line toward scientists and engineers, requiring their allegiance to projects that had immediate economic impact, secured national defense, and demonstrated the glory of Great Leader. Trained within a closed system that encouraged allegiance to Juche ideology, how could it be otherwise? Warning signs of this attitude toward specialists were present from the first one-, two-, and three-year plans, in which it was clear that so-called ivory-tower reasoning—an inadequate effort to focus research on the needs of the masses—would not be tolerated. The
The president of the Academy of Sciences pointed out that “scientists should not waste their energy and time doing research on useless, fantastic subjects. Rather they should concentrate on the problems which are vital to our national economy today and require an immediate solution... Our country does not have many scientists. It is important to solve the burning questions of the present, instead of going in for ‘far-reaching projects.’”

The North Korean Academy of Sciences has gone through numerous reorganizations of its various agencies, bureaus, and offices, reorganizations that reflect dissatisfaction with the performance of R and D. In the country’s three-, five-, and seven-year plans, R and D in heavy industry, metallurgy, electronics, heat engineering, material science, and much later biology had a central place. Yet even the motivational “February 17 Fast Combat Unit of Scientists and Engineers,” intended to promote engineering consultation and innovation in factories, performed dismally owing to inadequate funding. The theoretical sciences, including mathematics and physics, may have outperformed the others in this environment since they needed less equipment.

Leaders of the Korean Workers’ Party believed that Juche ideology would overcome all of these problems, but they underestimated the importance of international contacts to ensure the vitality of the scientific enterprise.

**Juche and Technology**

North Korean technological style developed its distinctive simplicity and awkward reliability because of the headlong pursuit of autarky and self-sufficiency. Great Leader offered the following watchwords: “Juche in ideology, independence in politics, self-reliance in the economy and self-defense in our national defense—these have been the invariable lines of our Party.” Party officials insisted that Juche did not hamper innovation, but fostered independent thinking. They understandably defended the need to develop their own processes and techniques. They could learn from the varied experiences of communists and workers around the world. But that experience came from the different conditions and specific features of each country. The more countries embarked on revolution and socialist construction, the more diverse and valuable experiences would be created. They believed that the decision whether to introduce the experience of a fraternal party had to be judged according to its own actual conditions and needs. No one could be allowed to interfere. Experience, they said, must be tested in practice, not mechanically copied—even as they mechanically copied western technology.
During his concluding speech at a plenary meeting of the Central Committee of the Workers’ Party of Korea in August 1960, Kim claimed that a technical revolution had fully emancipated the people from past oppression and exploitation. Against all odds—and in spite of the attitudes of skeptics abroad and renegades within the party—they had committed to learning and mastering many things in the technical sphere and had shown themselves fully capable. When the leaders first suggested manufacturing tractors, some people had “misgivings” and showed a “lack of confidence.” Yet, Kim Il Sung observed, “People who had never ridden in a car before are now capable of producing so many automobiles. The manufacture of excavators also seemed beyond us at first, but, on producing them, we found that they were, after all, nothing but big mechanical shovels.”

The North Koreans hubristically claimed successes in pursuing their own path of industrialization. Juche ideology—which meant that a developing country must rely on its own resources—grew out of these successes and out of the cult of Kim Il Sung. As a tool of foreign policy, Juche was aimed to attract the interest of other developing countries, although it claimed always to be Marxist-Leninist. This was a sharp break with the experience of the USSR, whose leaders recognized the need to extract leading technology from the advanced capitalist nations for application in socialist productive relations. The North Koreans called for revolution in productive relations with the assumption that this would lead to the creation of technologies of socialism. Yet since Juche required discipline, devotion, unquestioned hard work, and indeed militarization of labor, it also undoubtedly limited significantly personal and intellectual freedom. It handicapped innovative impulses while creating an attitude of self-contentment and superiority. The North Korean Workers’ Party would celebrate the launching of a 20,000-ton ship when South Korean shipbuilders were simultaneously launching 200,000-ton ships and shifting industry from Europe to Asia. According to a Swedish diplomat, this “do-it-yourself ideology” knew no bounds and was constantly indoctrinated into citizens so that they realized that every town was newly built, that the country was self-sufficient in food, that education and health care existed for all, that the countryside was electrified, and that captains of ships at sea might themselves operate on sick members of their crews, inspired by the thoughts of Kim Il Sung.

Did Juche promote independence, initiative, and creativity? Juche forced fierce independence to be sure, but also foolish insistence that indigenous ideas were always better. One Swedish engineer explained to Korean colleagues as an example that a 12 horsepower engine could power three drills at 4 horsepower
each, but no more. They insisted on four units, and he eventually realized that he must let them try—and fail—on their own. The Koreans pursued reverse engineering, which led them apparently to the systematic theft of all sorts of things, even door hardware, from foreign embassies in the attempt to manufacture those items in local industry. In the spirit of self-reliance they imported only what they thought was necessary to copy, but when it came to more complicated production processes they were not successful in timely start-up or operation. They did not comprehend that a technology is not a disembodied thing-in-itself, but usually a series of technologies, techniques, and attitudes about efficiency and labor tied into one. Yet they stubbornly persisted in pursuing their own tack in the face of failure even when repeated experience indicated otherwise.

Sungwoo Kim writes that Juche “mandates autarky through maximum reliance upon indigenous resources and technologies.” Like monthly and annual “storming” to meet targets in the USSR, Juche was coupled with a constant emphasis on speed and exhortation of the workers and farmers to improvise as best they could with crude local technology and materials in lieu of scientific methods. This often had great consequences down the road—missed production targets, cost overruns, environmentally suspect impacts—and there was no one to blame because Great Leader and Dear Leader were infallible.

Juche in part grew out of ideological conflicts between the USSR and the People’s Republic of China and conflicts between China and North Korea over cultural revolution. North Korea sought in foreign policy not to take sides in the developing Sino-Soviet dispute of the late 1950s. Kim Il Sung began to proselytize Juche in this environment, taking its other meanings beyond self-sufficiency to sovereignty and autonomy. Juche also reflected rising tensions between the working people and intellectuals. Kim Il Sung encouraged the intellectuals to join with the working masses in the innovation process. Having gained authority to make suggestions—and tacit permission to criticize the organization of the economy—the intellectuals thus became a point of concern. Kim Il Sung was not an intellectual, having finished only middle school. In this atmosphere, while encouraging self-sufficiency, Kim Il Sung also began to attack leading intellectuals. Not only western literature but even some classics of Marxism-Leninism were viewed as incommensurate with Juche, with Kim Il Sung’s teachings on Juche replacing instruction on dialectical materialism. Gulag-like labor camps and prisons in North Korea have become home to suspected dissidents.
The foundation of Kim Il Sung’s socialism, *Juche*, has remained a central feature of Korean daily life, labor, industry, science, and technology. *Juche* socialism required the assembling of mass armies of laborers to work with rudimentary tools owing to the underproduction of even such simple technologies as tractors, excavators, and bulldozers. *Juche* socialism required military and economic independence, isolation, and the development of racially pure, indigenous technology. *Juche* is truly “socialism in one country.” The 1992 revision of the constitution deleted references to Marxist-Leninist ideologies, while *Juche* became the “guiding principle” of the Korean Workers’ Party. Kim Jong Il criticized leaders of reform in other countries who had turned from socialism and embraced materialism as “renegades.”

Stalinist Agriculture in North Korea

Since investment for industrial self-sufficiency would be drawn from the countryside, and because of the belief that large-scale agriculture is more efficient than small house holdings, the party pursued collectivization. In this regard again Kim Il Sung was a Stalinist par excellence. Like Stalin, he pursued economic autarky, rapid industrialization, and war against the countryside to create a socialist fortress. Projects that seemed to serve the people or the consumer sector often were propaganda ploys, or even shams, perhaps a Pyongyang, if not Potemkin, village. For example, Kim Il Sung’s land reform of 1946 to break up large farms and distribute holdings to landless peasants and small tenants was only a short-term effort to attract southern sympathizers, stockpile grain, and repair the post–World War II economy in preparation for a future war of liberation. In the short term, agricultural production recovered from the war, and heavy industry developed. But this was a prelude to the “war of fatherland liberation,” the Korean War.

Kim Il Sung pursued “cooperativization” (as translated by North Korean sources) with purpose and certainty. He proudly proclaimed that the nation’s achievements in agriculture had proven foreign doubters wrong: even without modern farm machinery, cooperativization proceeded quickly. Kim Il Sung explained that the nation could not wait for the day when industry could mass-produce modern farm equipment. Rather, cooperativization was possible, and urgently needed, on the basis of transformation of outmoded production relations when sufficient revolutionary force has been gathered “even though modern farm machines may be nearly non-existent.” Whether the official state
agricultural production targets were outlandish or reports of overfulfillment were accurate is not the crucial point. Rather, we should recognize the impatience of communist leaders over transformation of “feudal” agriculture into modern socialist agriculture that would produce surpluses for urban inhabitants and export markets, as well as investment for industry.

While ultimately exploiting the countryside through extraction of resources, lack of investment, and starvation of the peasantry, at least in word the Korean Workers’ Party addressed the need to establish a healthy connection between the cities and countryside, or smychka as Trotsky and others called it. Kim Il Sung criticized the disjunction under capitalism between cities and the countryside, where lifestyle in the latter became desolate and living standards fell. But the communists, he declared, would eliminate this gap, create proportionality between the lives of peasants and workers, and not permit disparity to exist between rural and urban construction.\textsuperscript{59}

Kim Il Sung painted a rosy picture of agricultural development. He frequently spoke about the diversification of crops, vast increases in grain harvests, and the development of food processing industry that would facilitate “apartment-style” living. Perhaps he assumed that the Korean Workers’ Party had allocated sufficient resources to the program for collectivization of agriculture so that there was absolutely no danger of the mass starvation that struck Ukraine in the 1930s under Stalin. Kim never referred to the errors of Stalinist agricultural policy in any of his speeches. But he may have had that experience in mind when, in the 1960s, he discussed how his policies would “cooperativize” agriculture while increasing production substantially. Cooperativization would be based on industrialization of crop production, including expansion of grain and paddy rice through extensive application of chemical fertilizers, pesticides, and herbicides. Sown areas of grains would grow from 2.28 million to 2.52 million jungbo (a little less than a hectare), and even maize to 1 million jungbo in a few years. Breeding stock would double in number.\textsuperscript{60}

The fascination with increases in corn production seems to mirror that of Nikita Khrushchev—corn grew higher than an elephant’s eye after he visited Iowa in 1959; he had already called for an Iowa-like corn belt to be planted in Russia in a February 1955 speech.\textsuperscript{61} Apparently, the policy to plant corn did not consider soils, climate, or terrain adequately. In pursuit of corn at any cost, the system of exhortation, reward, and punishment led party officials to pursue extremely high density planting and heavy applications of chemicals. The area of arable land planted in corn increased from 10 percent in 1953 to 35 or 40 per-
cent in the 1990s, but maize production remained low, and widespread soil acidification resulted from overuse of chemicals.

Rather than smyčka, in North Korea deep contradictions arose between the city and the countryside, between the promise of mechanization and the reliance on labor, between rhetoric and reality. Kim Il Sung called for a technological revolution in the countryside based on a fourfold program of mechanization, electrification, chemicalization, and large-scale irrigation. He touted this as “an all people movement to remake nature on a large scale, to facilitate the use of tractors and other machines and the application of modern chemicals.” Kim Il Sung indicated that by 1961 over 90 percent of the countryside had been electrified and over 800,000 jungbo of land were irrigated, 7 times the level before the revolution. Might the nation produce sufficient numbers of tractors in the proper assortment, smaller ones for mountainous regions and larger ones in lowland fields, and through irrigation and electrification achieve unheard-of successes in agricultural output?

Kim Il Sung followed up his call for technical revolution with his “Theses on the Socialist Agrarian Question in Our Country” in 1964 on the need for technical and vocational progress in the countryside to strengthen collectivist forms of ownership and management. To succeed, this required the establishment of agricultural research and extension services to get that knowledge to the farmers. In his “Theses,” Kim Il Sung repeated the demand that more tractors be produced, but owing to military buildup, the resources for this task were not available. In addition, the personnel at the agricultural research and extension services were forced by Juche methods to ignore accepted international practice in modern agronomy that required soil science, hybridization, and other studies. Instead, Kim Il Sung stressed autarkic self-reliance in agriculture, reliance on the “creativity of the masses . . . based on concepts of ideology, technology and culture,” not on capital inputs. “Do yourself, do without, work around shortages and be inventive,” the Great Leader instructed. Yet people were arrested, interned, and beaten for planting corn in ways other than the Great Leader insisted.

Juche socialism resulted in agriculture being not only self-sufficient but also labor-intensive, insufficiently mechanized, and tied to harsh methods that destroyed land in search of harvest at any cost. In 1968 in the entire nation there were but 20,000 tractors (vs. over 1 million in the United States—in 1929). Perhaps because of the repeated failures of agriculture to perform at hoped-for levels, in the 1970s Kim Il Sung took personal interest in his “Theses.” He
ordered in 1972 that production of tractors increase to 30,000 units for the year, and that rice planters, harvesters, thrashers, and other machines be manufactured; the entire stock of tractors on farms in 1972 was only 30,000. The number of tractors in fact doubled in two years. In addition, there were significant investments in chemical fertilizers with the Namhung Youth Chemical Complex, an entirely imported facility. These two programs raised agricultural production somewhat, with grain leading the way. Yet the demands of the military always took precedence, and only direct intervention of Kim Il Sung could secure capital or labor inputs for agriculture when they were needed. Tractor production continued to lag, so that at the turn of the twenty-first century the nation had only 75,000 tractors. To make matters worse, the size of cooperative farms tended to be too small for tractors that at 25 horsepower or more dominated production, while shortages of fuel and spare parts limited their use.

In the 1970s and 1980s North Korean agricultural policies were directed toward solving endemic food shortages through another campaign of the “four improvements.” Extensive reclamation projects—irrigation, terracing, draining—increased the area of arable land. Improvement of infrastructure and rural living conditions and expansion of grain production were intended to establish self-sufficiency. Double-cropping and better varieties would raise production. Yet overuse of land and excessive application of fertilizers exacerbated the damage from natural disasters. Floods in 1995 caused widespread landslides in the terraced fields constructed in nationwide programs. Three hundred thousand hectares of land were inundated. After floods receded, 100,000 hectares remained covered in sand and gravel. As a solution, the government determined to abandon cooperative management, with cooperatives already under state control, for highly centralized state control.

Ultimately, it was impossible for peasants to be inventive and productive in the face of persistent shortages. The agricultural, forestry, and fisheries sectors of the economy declined in their share of investment and output. Roads, machinery, and other forms of infrastructure were inadequate to the tasks of farming. The share of the labor force engaged in agriculture also dropped from 57.6 percent in the 1960s to 34.4 percent in 1989, still a large number considering how poorly agriculture performed. One would expect a decline in the size of the peasant population, given a socialist regime’s allegiance to industrial development and the proletariat.

Kim Il Sung traveled hundreds of thousands of kilometers through the countryside to exhort the peasants to produce crops and see with his own eyes the
success of his brilliant program. How did he miss seeing 600,000 North Koreans (according to some estimates 2 million) who starved owing to the inhuman and failed policies of hyper-industrialization and cooperativization? Government policies permitted ownership of small family plots of 160 square meters, as well as a few pigs, chickens, fruit trees, and beehives. It allowed peasants to sell surplus at markets. Peasants had no surpluses, but starved. Vegetable farms, fruit production and storage, rice cultivation, fish farms, and soil and plant experimental stations all lagged. By 1979 the country’s leaders had recognized that stunted growth among children was a result of pervasive malnutrition. Kim Il Sung’s response was a campaign to plant runner beans around the fences of houses to avoid using up farmland. The beans would provide protein. The campaign made clear that “the people were on their own for survival, dwarfed growth and all.”

The collapse of the Soviet Union, a series of disastrous floods, reduction of investment to the agricultural sector, shortfalls of machinery, equipment, and seeds, incompetence, and cruelty all contributed to the famine. One North Korean resident recalled, “We used to live off from what we got through the Public Distribution System (PDS) without the Non-Public Distribution Management patches of land for growing crops for individual use. When the Public Distribution System suddenly stopped [in 1995], we even made porridge by cooking with the goosefoot plants for pigs and the fistful of powdered corn cob. People ate more grass than rice. More people died every year. That’s when the Republic began to see an increase in the number of thieves. When you planted potatoes or corn in your backyard and woke up the next day, you would find nothing there.” As in Stalinist systems generally, the periphery and the countryside served the center at great expense, including human expense.

Nature Transformation, Autarky, and Applied Science in North Korea

Perhaps captured by the aura of the massive projects completed under Soviet power and the claims of reclamation engineers in the USSR—the Kuibyshev Hydroelectric Power Station on the Volga River, the Volga-Don Canal, the planting of thousands of kilometers of forest defense belts—Kim Il Sung saw water melioration projects as essential to the construction of a socialist economy in the Democratic People’s Republic of Korea. If, in 1948, at Stalin’s request, the Communist Party of the Soviet Union had unanimously passed an audacious
project for the very “Transformation of Nature” itself, would Kim Il Sung be any less bold? Kim Il Sung called for “irrigation projects on a large scale and . . . river improvement and dyke projects for the protection of land.” He promised that the state would invest heavily in these projects, while “funds from the cooperatives and peasants themselves should be widely used for smaller projects.” Irrigation demanded pumps, transformers, generators, and motors that the country formerly imported “so we could not make decisions on our own and had to consult with those who were going to supply us.” With the creation of a machine-building industry, “now we have our say, and we have the right to decide” which pumps to use and how to use them.

Initially the projects lacked Stalinist scale. In August 1962 Kim Il Sung toured rural areas for about a week, during which time he called for continued efforts to build up local industry, not focusing exclusively on large factories. This would avoid problems of transport and more rapidly meet local demand, at the same time ensuring incentives to peasants to produce. He suggested a kind of Korean “machine in the garden,” with factories built at sites according to specific features of geography. “What a splendid job it is to build factories and develop industry in all parts of our country with its beautiful mountains and rivers!” he declared. Of course, decentralization of production also served defense purposes by requiring foreign aggressors to seek out dispersed strategic sites.

Ultimately, like the Stalinist USSR and National Socialist Germany, North Korea set out to transform nature in service of the state. North Korea embarked on aggressive, in many cases far-fetched, and ultimately unsuccessful projects to change nature itself given the failure to get industry or agriculture to perform well. The understandable rationale for large-scale irrigation projects was to preclude agricultural failure from drought and, through river improvements and reservoirs, to store water and prevent floods. One of the nature transformation projects involved terraced fields to cultivate much of the country’s slopes of hills and lower mountainsides. The effort to increase the amount of arable land by 10 percent resulted instead in extensive deforestation and heavy erosion, and production increased very little because of the inability of the soils to hold moisture and fertilizer. Fruit and vegetable plots located in narrow, high mountain valleys were rife for washout during heavy rain. Just as with Stalin’s Belomor (Baltic–White Sea) Canal, huge armies of poorly equipped laborers, many of them no doubt slave laborers, were mobilized to transform nature. In one case, according to the party newspapers, 100,000 hectares were brought under irrigation in only twenty days in 1977. The laborers “dug 42,000 wells and pools
and drove pipes into the ground” to irrigate an additional 100,000 hectares in another twenty days. “The organizational capability of our people is tremendous,” Kim Il Sung declared.75

In addition to irrigation and reclamation, engineers turned to hydroelectricity. This would secure self-sufficiency in energy production. But because of an inadequate scientific foundation to the projects that formed the core of the electrification program, frequent changes in direction of the projects, and a fascination with gigantomania without the requisite resources, energy capacity and production have never met the government’s plans. Scientists have had to show allegiance to bold, far-fetched projects and to withhold their independent expertise on project feasibility and the expected human and environmental costs. This meant that officials pushed ahead without considering those costs. They set forth plans to build hydroelectric power stations at seemingly every neck of every valley. This followed a pattern in the USSR where hydrologists studied the vast network of rivers from the European West to the Far East with the goal of building dozens of hydroelectric stations.76 At least the USSR had extensive coal and oil reserves to develop simultaneously.

As noted, the Japanese occupiers built the Soopoong Hydroelectric Station in 1943, the largest in Asia at the time (700 MW), and several other projects. Virtually all stations were destroyed during World War II and then largely rebuilt with Soviet aid. Several rivers could serve as sites for more stations, especially the Yalu River. But the Yalu, as the border with China, would require joint management and participation with China. Indeed, the Ubong Hydroelectric Power Station (400 MW) on the Yalu River, begun under Japanese occupation, was completed only in 1970, owing to tensions of the Sino-Soviet split that spilled over into Sino-Korean relations.77 Kim Il Sung endorsed major hydroelectricity projects on the Orangchon, Nam, Ryesong, and Yonghung Rivers that included aqueduct tunnels to take advantage of deep slope and enormous head possible in mountains. By 1962 specialists had apparently completed surveys of North Korea’s hydroelectric resources, nine-tenths of those available on the entire Korean Peninsula. The surveys indicated 200 suitable spots for dams on sixty-four rivers with capacity potential of 8 million kW capacity, with the Yalu River offering the Supung (700 MW), Hochungang (338 MW), Changjin (326 MW), and Punjongang (201 MW). The rated megawatts for these projects indicate that North Korea had yet to standardize production of turbogenerators in 100 MW, 200 MW, or larger that might be used at any site. And, if the three- and five-year plans were
intended to expand hydroelectricity production and facilitate transmission with lines and transformer networks of 1,300 kilometers,\textsuperscript{78} this indicated quite a modest network considering the huge quantities of electricity to be generated. Production would far outstrip distribution capacity and demand. Visionary plans were rarely rational plans.

Tunnels were to be built deep underground through almost inaccessible mountains to divert river and stream flow to the steep slopes. Yet even using military transports and helicopters, it was hard to get cement trucks and other equipment to the sites in the mountains. Elite Army engineers planned the Kumgangsan Power Station to divert three rivers originating in Mt. Kumgang from draining into the West Sea toward a new delta in the East Sea. The project included a 300-meter waterfall collected in four reservoirs and descended through seven interconnected tunnels that required boring through granite. The engineers failed to measure up to the those of the U.S. Army Corps of Engineers, whose multibillion dollar projects would frequently suffer from cost overruns but would meet targets. Planned at 810 MW, Kumgang operates at only 100 MW. It diverted resources from other projects that also fell far short of their targets, and it appears that extensive repairs have already had to be completed, including crude concrete rewrapping. In spite of being a campaign priority, modern technology lags even in this area of the economy. To illuminate what they have achieved, the North Koreans have had to turn to floating wheel turbines and dirt and wood hydroelectric dams that harkened to a previous era.\textsuperscript{79}

Mirroring Stalin’s 1948 plan to transform nature, North Korean leaders advanced the West Sea Barrage, which would have created the longest dam in the world at 8 kilometers long, cutting across rough sea at the Taedong River estuary. The project was important for its potential to serve the leaders, the party elite, and the urban residents of Pyongyang at the expense of the peasants. The project created a huge reservoir of nearly 400 cubic kilometers capacity and required the excavation of 15 million cubic meters of earth, the transport of 16 million cubic meters of gravel, and the pouring of 2 million cubic meters of concrete. Three divisions of the army soldiers were conscripted to the project, which cost, according to some estimates, 9 percent of GNP. Planners touted its contribution to irrigation, but they overestimated this contribution. The goal was to create new tidelands and irrigate them. When proposed in 1961, Kim declared that 50,000 hectares of tidal flats would be reclaimed. In a few years, planners revised the forecast downward to 30,000 hectares. Another project, approved at 100,000 hectares, resulted in irrigation of only 34,000 hectares.
Bulldozers, excavators, tractors, trucks, rail cars, barges, cement, fuel, logs, and iron were requisitioned, yet all were in short supply owing to endemic bottlenecks in the economy that plagued this project no less than mines, steel mills, and hydroelectric projects. In essence, the country relied only on labor inputs; capital was tight.

Constant failure was no obstacle to other, more ambitious plans. The fourth plenary session of the Central Committee in 1981 approved “nature-remaking programs” to solve persistent food problems. The engineers designed dikes to close the mouths of bays, built embankments, and reclaimed five tidal flats in the 1980s and 1990s. With over 70 percent of precipitation in July and August, and hence the desirability of huge water storage capacity, North Korea had to turn to irrigation, reclamation, and storage through canals, pumping stations, and reservoirs. When irrigation systems were built into the mountainous regions, the process accelerated erosion and triggered mudslides into reservoirs. According to some estimates, the Korean laborers constructed 80,000 artificial lakes, 1,700 reservoirs, 25,210 pumping stations, 124,000 groundwater facilities, and 40,000 kilometers of flumes. The reservoirs were poorly if rapidly built, using earth and stone piled haphazardly, leaving them vulnerable to saturation and flood. A number disappeared in flood waters in the 1990s. When Kim Il Sung died in 1994, government reclamation projects were at least 280,000 hectares behind goals of reclamation of 300,000 hectares of tidelands and 200,000 hectares of unused lands.80

Finding trouble in bending nature through “splendid projects” centered on irrigation powered by hydroelectricity, Kim Il Sung and his planners therefore turned to thermal power generation, a reasonable idea owing to the country’s anthracite reserves. Yet the effort to supply thermal stations triggered a persistent coal shortage because of technologically backward mining techniques that could hardly meet targets in any hour, let alone any month. Miners used outdated blasting to break up coal seams, not machines that could do 50 times the work that were widely available in other countries. Not only machines were lacking. Said Kim Il Sung in 1982, “If the workers of the Anju Area Coal Mining Complex are merely supplied with safety lamps and hand tools, they will most likely be able to double the present output of coal.” That is, miners had rudimentary tools and inadequate safety equipment. The Anju fields were also plagued by flooding and inadequate efforts to build drainage tunnels since the goal was immediate extraction.81

Dear Leader, Kim Jong Il, has followed in his father’s impressive footsteps,
by redoubling efforts to build hydroelectric power stations. Even in the face of famine, he discovered investment capital to return to several of the rivers his father had visited, with the hope of adding additional power stations. In February 2005, according to the Korean Central News Agency, General Secretary Kim Jong Il “gave field guidance to the newly built Orangchon Power Station No. 1 and the Jangyonho Fish Farm.” The report noted that Kim Jong Il “acquainted himself in detail with the construction of the power station.” He expressed “great satisfaction” over the plant’s rational design and high quality and “over the fact that the people of the province have built a modern power station.” Visiting the construction site, he “called upon the members of the youth shock brigade and other builders to speed up the construction of the dam with the same vim and vigor with which they built the power station No. 1 in a brief span of time and thus complete the remaining project ahead of schedule.” Kim Jong Il then gave “guidance” at the nearby Jangyonho Fish Farm. The report concluded, “He learned in detail how fishes are bred on the farm, going round fish ponds, spawning rooms and various other places of the farm. He set forth highly important tasks which would serve as guidelines for conducting fish breeding as a widespread mass movement.” Not quite the same guidance as his father gave for bean paste or ducks, but piscine guidance nonetheless, and a mass movement at that.

North Korean Stakhanovism: The Chollima Movement

In the face of daunting technological obstacles, unwillingness to trust experts completely, and centralized planning mechanisms that created bottlenecks and shortages, only exhortation of workers provided any hope of increasing the pace of nature transformation, agricultural production, industrial growth, and expansion of mines. Korean Stakhanovism—the imported Soviet technique of identifying leading workers to establish new norms for production with old tools—proved successful at raising output and ensuring allegiance to the cause in a symbolic rather than an absolute fashion. Stakhanov was the Don Basin miner who established superhuman norms for the mining of coal seams and was held up as an example in many other sectors of the economy. In the absence of material incentives or higher salaries, exhortation to fulfill individual norms and establish new standards became the rule, spreading from mining and metallurgy eventually into all sectors of the Soviet economy: fisheries, forestry, road grading, and teaching.
North Korean Stakhanovism was called the Chollima Movement, named after a Legendary Flying Horse. The Chollima Movement was launched at the Chollima Kangson Steel Works in December 1956 to stimulate worker enthusiasm and initiative and to spur workers to carry out socialist industrialization to repel such imperialist nations as the United States. In orchestrated visits that were hardly as spontaneous as press reports indicated, Kim Il Sung himself dropped in for visits to such facilities as the Kangson and the Hwanghae Iron Works to “rouse . . . the workers to a [sic] heroic exploits in their labour struggle.” During his visit to the Chollima mill, the workers vowed to produce 90,000 tons of rolled steel at a mill with a capacity of 60,000 tons, and then they turned out the miracle of 120,000 tons in response to the Leader’s appeal “Let us dash forward at the speed of Chollima!” 83

The frenzy of smelting spawned the Chollima Work Team Movement to encourage workers to establish and surpass targets in all fields of the economy. North Korea had resorted to other campaigns standard in socialist systems to increase output in the absence of inputs. The so-called socialist competition was extended to agriculture in March 1961. 84 Socialist competitions have a Soviet legacy dating to the 1930s, when they were introduced to motivate workers to achieve targets. According to the socialist obligation, which the worker “voluntarily” and “willingly” embraced, the worker declared the goal of reaching such and such a target in competition with other workers at other enterprises. In the absence of incentives of wages or goods or other rewards, the government had to resort to titles, badges, or flags. Practically everyone got an award at some point, so the honorary titles became meaningless. In North Korea this led to the proliferation of categories and titles, for example, People’s Hero, Class I, II, III, 85 and so on.

The Chollima Movement accelerated apparently in response to the People’s Republic of China’s Great Leap Forward (1958–60) of simultaneous industrialization and collectivization. It created similar difficulties of short supplies, bottlenecks, and all too often shoddy construction. Because of the absence of capital inputs (and incentives, as noted), the Chollima Movement relied on mass meetings and coveted titles to encourage labor. This provoked tension among workers; model workers were often ostracized because other workers accused them of forcing everyone to work harder. Authorities turned to model brigades to involve more laborers and ease the tension. The Chollima Movement involved 438,000 people by 1960. By August 1961, 2 million people were engaged in the movement in nearly 5,000 work teams and work shops, including 125,028 peo-
people who earned the title of Chollima, and fifty-five work teams with nearly 1,500 laborers who were honored with the title of “Twice Chollima.” In 1963 over 3 million people were engaged in Korean Stakhanovism, with hundreds of thousands of workers receiving Chollima medals. Some observers noted that the movement would have “built-in tendencies” to exaggerate output and cause disproportionate growth among different sectors.\(^8^7\)

The Chollima Movement involved unquestioned enthusiasm for big technology, new norms, and self-proclaimed grandiosity of turning wastelands into a socialist industrial garden. As workers achieved each new unfathomable target, the leaders established still higher targets to ensure “strenuous effort and energetic struggle” to increase outputs and to fight complacency.\(^8^8\) As Kim Il Sung noted in 1961, “Our heroic working class built in less than a year 300,000–400,000 ton capacity furnaces, laid in seventy-five days over eighty kilometers long broad gauge railway and set up in a little over one year a huge, up-to-date vinalon factory.” He noted that “the grandiose high tide of socialist construction and the Chollima movement” were natural outcomes of the revolution. It had become a mass movement that encouraged “labor enthusiasm,” while overcoming such “hindrances” as capital shortages through “incessant enhancement of political and ideological consciousness of the masses.”\(^8^9\) Chollima would encourage the creative cooperation of the “broad working masses and peasants with scientists and technicians” to develop indigenous science and technique with “incessant technical innovations” and always increased tempos.\(^9^0\)

North Korean leadership responded to any hesitation among critics within the party or elsewhere by storming ahead with indignation. Kim Il Sung constantly cajoled local party leaders to do what they could to raise production. He promised in return the rewards of a life of plenty. He said, “Instead of 3,800,000 tons we must raise the grain output to at least five million tons, and even up to the six million or seven-million-ton mark. Only this will enable everyone in the northern half to live on rice, as we say. If we reach a point in which we can eat rice and meat soup, wear fine clothes and live in tile-roofed houses, that is, paradise.”\(^9^1\)

Campaigns like Chollima reflected an epidemic of dysfunction in the centrally planned economy. The “one-machine-tool-makes-another” campaign of 1959 was an emergency measure to double the number of machine tools by encouraging workers to find ways to put sweat, metal, and ingenuity together. More than 13,000 new tools were produced in this way, but indications are that quality, precision, and reliability were not features of these machines. Another
campaign, the “production innovator,” resembled the Stakhanovite movement in encouraging overfulfillment of norms. The Taean Management System found fertile ground in this environment in the effort to rationalize leadership, material supply, and worker welfare. As noted, the chief engineer was subordinate to the factory manager. Reliance on such nonmaterial incentives as mass movements, competitions, and political exhortation also was evident in the Chongsan-ri; the “Pyongyang speed,” “Kangson speed,” and “Let’s Fulfill the Plan as a Present to the Fifth Congress” mass production campaigns; and the “carrying-one-more-load,” “run while carrying loads on head and back,” and “watching the early star” movements, all of which sought to promote self-sufficiency and autarky in the absence of domestic capital inputs or technology from abroad. The campaigns led neither to paradise nor to the harvest of more rice.

Socialist realism in the sphere of art reflected all of these campaigns in the economic sphere. In keeping with the socialist experience, the North Koreans promoted socialist realist art to inculcate values of selflessness, self-reliance, communalism, and the like. Juche guided this art in stressing themes that indicated the power, independence, and glory of the Korean worker. Art served the people through such themes as loyalty to the task at hand, pride in country, love of the Great Leader, victory over enemies, and control over nature. Posters, paintings, and murals blanketed walls everywhere. As in the Soviet Union, all artists and writers in North Korea were members of the artists’ and writers’ unions, from which they received salaries. They were required to produce works of art according to plans, not necessarily according to artistic inspiration. Leading officials of the unions ensured that works met standards for socialist realism, and they ostracized those who did not comply. Of course, abstract art was forbidden.

Socialist realist art, theater, and music failed to inspire because of its superficiality, its simple-mindedness, its thematic messages limited to the successful fulfillment of the plan, industrial production, or agricultural bounty, and its depictions of life as struggle between good and evil with no shades in between, for example, between the proletarian Korean and the American missionary. Han Sorya, the chairman of the Writers’ Union, a protégé of Kim Il Sung, and later minister of education, was a kind of “curator of the personality cult” through his literature. In addition, placards, posters, monuments, and postage stamps commemorate the glories of socialist industry and of the constant struggle against imperialist aggression. Issued on the tenth anniversary of the People’s
Army in 1958, stamps included a ten-won denomination with a soldier, flag, and the Hwanghae Iron Works in the background. In 1961 the government issued a series of stamps of different denominations in honor of the targets of the first seven-year plan, in which cogwheels figured prominently at textile, agricultural, power station, and other settings.

During the de-Stalinization thaw, abstract art reappeared in many forums in the Soviet Union. Like Kim Il Sung, Nikita Khrushchev detested abstract art. Realizing this, several conservative members of the Central Committee arranged for Khrushchev to visit a new exhibition of abstract paintings at a gallery in Moscow in 1962. Taking in a few of the paintings, Khrushchev turned beet red and then berated the artist in front of the crowd: “You ought to be ashamed of yourself. You ought to be taken out into a field of nettles, have your pants pulled off, and be forced to sit down.” No North Korean artist risked Kim Il Sung’s wrath. The punishment might have been to sit in kimchi.

Urban and Infrastructural Technologies of State Power

There is less evidence among the North Koreans of blind love for prefabricated concrete structures than among Soviet and East European communists. Still, in his speech at the third session of the second supreme people’s assembly in June 1958, Kim Il Sung announced that mass production techniques would be applied to building new modern houses on a large scale (with, of course, nursery schools, kindergartens, clinics, and laundries also to be erected), all on the basis of “assembly-line methods” and “mechanization” of construction. The workers themselves, heeding this announcement, pledged to increase threefold their construction of houses in the current year. Kim Il Sung was also enamored of bricks, although he worried about shortages as demand for them increased, even with 700 to 800 million bricks produced annually. Just before the war, they decided to build a brickyard at Kangnam. But as skilled workers had been scattered across the land by war, political disarray, and family disintegration, there was no one to build it properly. The remaining workers erected a chimney that drew poorly. It was destroyed by enemy bombing and then rebuilt again. Kim Il Sung recalled, “It was not easy even to make a brick; we did not know how to build a smokestack; and as we did not know how to make an estimate of the number of bricks needed, we were obliged to resort to a crude method of reckoning.” Seven years later Kim Il Sung claimed that calculations of how many bricks and blocks were needed had replaced crude reckoning.
Simple smokestacks were not the only problem. In spite of their importance to state goals, the development of transportation and communications infrastructure lagged in the workers’ paradise. Expenditures for roads, railroads, shipping, and air travel are usually intended to support state efforts to industrialize and build military might. Yet rural transportation infrastructure lags significantly behind needs, especially in socialist systems, even though without good roads the farmers encounter great difficulties in meeting planting, harvesting, refrigeration, and delivery targets. Dirt and gravel roads—muddy and impassible much of the year—predominate in Russia, North Korea, and other industrial nations to this day; asphalt is a dream of local residents and traffic planners. In spite of the rhetoric of the decentralization of investment, the crucial place of agriculture in the socialist future, and the call for local industry, the Great Leader’s capital city of Pyongyang swallowed capital and labor inputs, including brick, asphalt, and concrete by the mouthful. By 1974 most villages still resembled traditional peasant settlements, while Pyongyang was “an enormous 1950s sprawling European city suburb. By the late 1980s the Koreans were completing a new housing area with thirty-storey buildings along a six-km motorway. They had built a large triumphal arch which spanned a five-lane road in the city center,” and a colossal Juche tower to honor the leader’s seventieth birthday that included as many stones as days he had lived.98 One massive thirteen-lane highway runs from high-rise apartments in one suburb to the downtown.

Authoritarian regimes tend to be superb developers of public transportation systems. These systems are a necessity in the absence of extensive highways and roads or a large number of private automobile owners, and they make a great deal of economic and environmental sense wherever they are properly designed and introduced. Combined with subways and comprehensive tram, trolley-bus, and bus lines, they enable workers to commute large distances at relatively high speed and at low cost. The systems also often serve the function of display value, that is, the ideological goal of demonstrating the superiority of the authoritarian regime over other regimes. For example, the metro stations in the USSR built under Stalin were works of art, self-proclaimed “palaces” constructed out of marble and other expensive materials and filled with murals that depicted historical events and moments of indoctrination, for example, the happy worker building communism.

The North Korean transport system has been limited in effectiveness because of the simultaneous construction of related but unnecessary facilities. Kim Il Sung determined to build sports and cultural facilities in Pyongyang that glori-
fied his enlightened rule, replete with glorious thoroughfares and modern subway. In 1989, to rival the Seoul Olympics when efforts to cohost the games failed, Kim Il Sung ordered the construction of Youth and Kwangbok Streets for the World Festival of Youth and Students. Laborers built 260 major facilities in two years. They completed the Pyongyang-Kaesong Expressway, an unnecessary extravagance given this bicycle and train society. Youth Street was for sports and culture; Kwangbok Street was for apartments and shopping. Twelve athletic facilities aligned Youth Street, including the 150,000-seat Rungnado Stadium, a 4,000-seat table tennis arena, a 20,000-square-meter swimming pool, and several hotels, including the worthless Ryugyong, a 105-storey, 300-meter-tall unfinished structure. Kwangbok Street has a subway, high rises, and apartments.

The two-line Pyongyang Subway also was a monument to modern socialism and the cult of personality of North Korean leaders. The stations feature murals and bronze reliefs, like those of Soviet metro stations, that glorify communist construction, the innovativeness of the people, and, of course, Kim Il Sung. The two lines, the Chollima Line and the Hyoksin Line, comprise seventeen stations over 34 kilometers. The stations are named Comrade, Victory, Construction, and so on, not after neighborhoods. The lines are deep underground, perhaps the deepest in the world at 130 meters. Western intelligence observers say they are linked to military facilities. Platform entrances hardened by tons of concrete and zinc to withstand a nuclear explosion bear this out. And, in keeping with North Korean technological style, several stations have been closed for weeks at a time because of flooding.

Otherwise, transportation has lagged significantly behind economic needs. Inadequate infrastructure, especially in interior agricultural regions, made it difficult to harvest and move agricultural products. Refrigeration also lagged. Much of the transport system was rebuilt after the Korean War, yet in 1990 there were only 5,000 kilometers of railroad, most of it along the coasts, quite a small amount given the fact that 90 percent of all freight was hauled by rail. Efforts at electrification, containerization, and modernization of rail transport have been slow. There are roughly 23,000 to 30,000 kilometers of roads, very few of them paved, most of them gravel, crushed stone, and dirt. Vehicles mostly serve the military; rural bus service is spotty, slow, and uncomfortable, although most cities have bus and tram service.

Kim Il Sung purged a so-called antiparty group in the late 1950s as a sign of dissatisfaction with de-Stalinization. The burgeoning cult of personality of Kim Il Sung indicated just one measure of rejection of de-Stalinization. Another was the continued embrace of large-scale technologies whose ideological sig-
nificance often surpassed social function, for example, the construction of build-
ings with massive edifices to signify state power: the Tower of the *Juche* Idea, dozens of statues of Kim Il Sung at least 20 meters high, and later Kim Il Sung's grotesquely expansive mausoleum.

The North Korean state, like the Nazi and Soviet governments, uses its com-
plete control over the media for propaganda purposes. As might be expected, very few homes and apartments have telephone service. The Propaganda and Agitation Department of the Korean Workers’ Party uses approximately two
dozen AM and ten FM stations and eleven television stations to carry official broadcasts. The government has mounted public loudspeakers everywhere to carry its messages.

**Pseudoscience Korean Style**

Autarky, centralization, and the primacy of ideology made a Lysenkoist-type figure a possibility in North Korea. In the 1960s Dr. Bong Han Kim advanced a theory that demonstrated the independent existence of a life force crucial to oriental medicine. Party technocrats embraced the theory as a major scientific achievement that reflected *Juche* socialism and enabled national self-reliance. The technocrats supported this theory with financing and institutional backing and made possible experimental verification of Bong Han theory as a “commu-
nist science.” This led Bong Han theory to become an academic discipline as a part of oriental medicine, but also increasingly ideological, less empirical, and ultimately incorrect.\(^{102}\) It should be mentioned that a number of specialists in the area of homeopathic and other alternative medicines claim that Bong Han theory held great promise and was rejected by westerners simply because of its North Korean origins. On the other hand, claims that it would cure diseases considered incurable by western doctors have not been proven.

Given poor funding of R and D and the short rein given scientists to embark on new projects, it is not surprising that North Korean specialists have few indigenous discoveries or applications that resulted from *Juche*, or self-reliant science. Another pseudoscientific effort in North Korea involved the costly and ultimately unsuccessful effort to create a cotton and nylon substitute in organic chemistry. Cotton will not grow well in Korea, so vinalon, a nylon-like chemical fiber developed from limestone and coal, both of which are plentiful in Korea, was a welcome substitute with a variety of applications. Vinalon was also Korean in genesis, and this secured its favor among leaders. The factories to manufac-
ture it received significant investments, while other factories struggled to keep
rudimentary machinery functioning. The stress on raw materials for fibers reflected needs of industry, military, and the civilian sector. The country slowly built or rebuilt a number of textile mills and silk mills. Yet demand grew and grew. The party therefore marshaled its “meager” resources to push the chemical industry to produce artificial fibers. This led to the construction of the Sunchon Vinalon Complex to produce the nylon-like fiber.\textsuperscript{103}

Ri Sung Gi, a chemist who had studied in Japan, synthesized the fiber in 1939. Communist leaders invited Dr. Ri to the north from Seoul National University where he had settled. They offered him a spacious, well-equipped laboratory in Hamhung, a major city of the chemical industry, and a position as branch president of the National Academy of Sciences. Having seen his discovery ignored in the south, he relocated—or as the South Koreans say, “defected.” The Sunchon Vinalon Complex was completed in May 1961 and opened with great fanfare, having gained Great Leader’s attention and support. The 500,000 square meter factory consisted of thirty large structures, 15,000 machines and installations, and 500 kilometers of conduit and piping. “Our working people have miraculously finished this gigantic project by their own techniques and efforts in a little over one year,” Great Leader observed.\textsuperscript{104}

Another plant nearby was launched in 1986 to produce 100,000 metric tons of vinalon annually, plus methanol, vinyl chloride, sodium carbonate, nitrogenous fertilizers, and other products with consumer applications to improve people’s standard of living. However, this facility has not met output targets, like the first factory produces an inferior product, was never fully completed, and has experienced a series of explosions.\textsuperscript{105} Still, party officials frequently referred to the factory as demonstration of the success of \textit{juche} ideology. For his efforts, Ri received a Lenin Prize in 1962 and in 1965 was appointed head of the North Korean Atomic Energy Research Institute. Western specialists believe that the vinalon facility and perhaps several other plants that produce vinalon are also involved in the production of chemical weapons.

The Kims’ Nuclear and Missile Programs

Given its autarkic economy, its leaders’ willingness to sacrifice the public good in the pursuit of state technological programs, and its deep, some would say reasonable fear of attack from the United States, it is not surprising that North Korea has pursued nuclear and missile brinkmanship. North Korea’s nuclear and missile programs give western policy makers greater worry. The tests of
seven missiles in June 2006 flabbergasted Japanese and angered western leaders even if the tests were unsuccessful. What might be accomplished through diplomacy to slow North Korea’s nuclear and missile ambitions and to encourage the nation to follow international regimes is not my major concern here. Rather, I pursue the question, what is Stalinist about North Korean missiles and reactors?

First, like the program of Cuba or Argentina, nuclear and space sciences serve to augment the country’s self-image as a modern power. But unlike Cuba or Argentina, North Korea has produced nuclear devices for defensive purposes. The extensive nuclear program began in 1955 when scientists from the Korean Academy of Sciences participated in a major conference on the peaceful uses of atomic energy in Moscow. In 1956 government officials signed a number of bilateral agreements with the USSR and new ones in 1959 and also with China. The USSR agreed to set up a research facility near Yongbyon and support curriculum development at Kim Il Sung University. Soviet specialists provided a standard IRT-2000 experimental reactor at Yongbyon that commenced operation in 1967; Korean officials placed the reactor under IAEA controls from July 1977. In the mid-1970s, as cold war tensions simmered, the nation began to expand these facilities, for example, by building an indigenously designed, graphite-moderated, gas-cooled 30 MW reactor whose functions included plutonium production. The reactor began operation in 1987. North Korea then added fuel processing and other facilities enabling scientists to complete the fuel cycle. Scientists at the Laser Research Institute may be involved in a uranium enrichment program.106

Western students often have a difficult time understanding North Korea’s bellicosity. North Korea justifies its military programs because of a long history of violent foreign intervention. China dominated what is now Korea for centuries. Japan exploited Korea from 1910 until 1945, expropriating half of the rice production and placing women into sex slavery. The Treaty of Portsmouth (New Hampshire), which ended the Russo-Japanese War in 1905, gave Japan “paramount political, military and economic interests” in Korea, which it used to develop industry in the northeast corner of the Korean Peninsula. Kim Jong Il claims to have defied the legacy of his father only once, in 1991, when he hesitated to divert government resources from the military to raise the standard of living of the people. With the fall of the Berlin Wall in 1989, the disintegration of the Soviet Union, the expectation of the United States that North Korea would follow along the clear and well-illuminated road to democracy, and the
Gulf War against Iraq in 1991, Kim Il Sung anticipated a U.S. attack on his country. North Korea’s former allies had looked the other way; subsidized oil imports from Russia dropped 50 percent. The USSR had once before turned away from North Korea when it sought closer relations with China. Kim Il Sung admitted that “North Korean guns are so outdated that few are computer-operated,” but that Korea was capable of both defending its own borders and “stinging US soil like a scorpion” with ICMBs targeted at New York, Chicago, and Washington. Kim Jong Il therefore justified continued efforts to develop ICBMs, nuclear weapons, and other military hardware, no matter the costs. National mobilization, the creation of a fortress nation, and modernization of the defense industry all remained priorities.

Through reverse engineering and outright purchase, North Korea has developed an extensive missile program. The missiles are based on Chinese and Soviet models, often acquired through such third countries as Egypt, Iran, Syria, and Libya. Korea has missile-testing grounds on the eastern coast north of Wonsan, has produced a ballistic missile with a range of 900 kilometers, and soon will have an intercontinental ballistic missile with a range of 6,000 kilometers. Although struggling to feed its people, the country deployed tanks, artillery, mortars, rocket launchers, and surface-to-surface missiles and sought missile and nuclear technologies, the former of which it acquired through Egypt (scud missiles) and reverse engineering. The country’s scientists extended the range of the Rodong-1 scud missile to 1,000 kilometers and eventually designed Taepo
ong multiple-engine missiles with ranges of 4,000 km. The first launch of a Taepo
ong missile in August 1998 reminded South Korea, Japan, and the United States that the fortress state remained capable of military strikes even as the economy struggled. The state combined these military achievements with Juche to deify Kim Il Sung, who, as a god on earth, had protected the nation from invasion. The government glorified the sacrifice of the masses, in face of their starvation, as part of the struggle in the “Arduous March” to reunification with the south, which they undertook while they sang “Song of General Kim Jong Il.”

Will There Be Kimchi?

The song of the Great Leader and the Dear Leader consists of dozens of verses in a technological hymn. As this brief review of the history of several large-scale technological systems indicates, the genesis of industrial, agricultural, communications and transport, geoengineering, and military technologies in North
Korea reflects political, economic, and \textit{Juche} ideological desiderata. Those desiderata include the Stalinist pursuit of collectivization of agriculture, rapid industrialization, and bold nature transformation projects. Because of the heavily centralized planning system that arose under Soviet influence, the projects acquired substantial momentum. Exclusion of public concerns, including those of engineers and scientists themselves, about environmental and social costs of development projects grew out of a closed, highly secretive one-party, charismatic political system. An overriding emphasis on applied science, on the allegiance of scientists and engineers to the masses in ways determined by officials of the Korean Workers’ Party, and on military research and development also shaped Korean large-scale technological systems.

North Korea’s autarkic industrial and technological policy reflects the presence of a command economy, emphasis on heavy industry, and \textit{Juche} socialism. State ownership of the means of production, including the scientific research and development apparatus, ensured an orientation toward industry and such large-scale nature transformation projects as dams and irrigation systems. The Academy and State Committee for Science and Technology shaped the North Korean engineering sciences by administration fiat from above, not demand of the enterprises, and certainly not consumer demand. This approach has worked more successfully in missile development, nuclear energy, computer software, large-scale construction, and other campaign efforts than it has in innovation generally or civilian technologies. And having adopted self-reliance, the establishment no longer has access to turnkey plants or other sources of learning from abroad.\textsuperscript{109}

Planners’ preferences, autarky, and Kim Il Sung’s cult of personality determined that North Korean development favored such heavy industry as construction, chemical fertilizers and fuels, mining, and metallurgy. Plans failed to include adequate resources for agriculture or consumer goods. And like other authoritarian political systems, its closed nature has engendered pseudoscientific efforts à la Lysenko to accelerate industrial production and modernize agriculture but has not ensured rational use of resources. Indeed, whether it be vinalon, which seems to be without counterpart elsewhere, or the massive, costly, environmentally dangerous dam, canal, and other nature transformation projects, North Korean science and technology seem rarely to have served those whom rhetoric proclaims to serve: the poor peasant and worker. For Stalinist technology is technology for the state, not for the citizen. Kim Il Sung promised bean paste, kimchi, and ducks. He could not even deliver tractors.
Masabikh Akhunov (1928–2008), “The Novovorenezh Nuclear Power Plant,” 1983, linocut. Nuclear power assumed central importance to the effort to provide more and more electrical power to the socialist state, in part through the serial production of nuclear power stations and their installation in reactor “parks,” here at Novovorenezh, Russia. Perhaps as a sign of continuity with the Soviet era, Russian engineers today are building floating nuclear power stations. Courtesy of the Allan Gamborg Gallery, Moscow, Russia.