Globalization of Science and Repression of Scientists in Mexico

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In this article, recent changes in the Mexican research system are examined. The restructuring of the global political economy and a severe crisis of legitimacy in the Mexican political system have generated a turn toward neoliberalism by the ruling party in a bid to attract foreign investment. A key component of neoliberal science policy is the Sistema Nacional de Investigadores (SNI), a system of salary increments for selected researchers instituted during the 1980s. Examination of SNI's decisions reveals numerous discriminatory and self-serving practices that are inconsistent with widely accepted norms in the scientific community. During the same period, repressive actions against researchers, such as the peremptory closure of research institutions, firings of researchers, and direct intimidation, have increased. The victims of discrimination and repression documented here are disproportionately foreign-born Mexicans, leftists, critics of the ruling party, and researchers in environmental and energy studies.

In recent years, Mexican scientists have been the victims of numerous adverse decisions taken by state authorities, including firings, salary reductions, and closure of research institutions without benefit of either public debate or independent scientific review. These actions may have seriously affected an effort launched during the 1970s to build up indigenous scientific capabilities in Mexico. Our purpose here is to examine their roots in political-economic shifts that are both uniquely Mexican and global in character. The core of our argument is that the interactions of Mexican with global or transnational forces over the past two decades and the decomposi-

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tion of the Mexican political system have progressively undermined indigenous capabilities for science and inquiry.

At several junctures of modern Mexican history, political repression has reached levels that are comparable in kind (although not necessarily scale) to those in some South American dictatorships. By comparison, the events that we discuss in this article may seem mild in both their scope and intensity. However, these developments come at a time of profound change in the regional and global political economy and increased politicization of science in society (Kolko 1988; Dickson 1984; Latour 1991). In addition to their consequences in terms of human and civil rights, the adverse changes in the Mexican research system[1] are therefore significant because they tend to impair the capacity for visualization and action by an important professional group at a time of profound political-economic realignment. We consequently view the plight of Mexican scientists as a form of repression that not only victimizes specific individuals and a particular professional group but also diminishes the vitality of the civic realm in which common needs are addressed and mediated.

In framing this inquiry, we do not posit a simple connection between global change and repression. We argue instead that there is sufficient association to make it naive to view these phenomena as isolated and worthwhile to explore their interdependencies. The next four sections address our concept of a global or transnational political economy, the historical context of science and industry in Mexico, and new patterns of discrimination and repression associated with the restructuring of the research system. We then examine more explicitly the collapse of a nationalist science policy in Mexico and the consolidation of a transnational model of science and industry as interconnected processes.

Global versus International Organizations

A global or transnational political economy is one in which the nation-state is both politically and organizationally eclipsed by social units that enjoy significant autonomy from territorially defined political power. Some radical theories (most notably Wallerstein's world-system theory) have long held that Western imperialism is driven by a global process of capital accumulation, which implies the political subordination of the nation-state to capital. However, it is only in the past few decades that this domination by capital has taken the concrete organizational form of the transnational corporation.

A transnational corporation is different from an international or multinational corporation. The latter exports its products through a network of

affiliates in foreign countries or procures key inputs on an international basis but is controlled from a headquarters that concentrates all functional components at a single site or in a single country. In contrast to this, a company is global when functional resources (e.g., manufacturing, marketing, research and development, accounting, assembly, etc.) are distributed around the globe. Top management will be in a single location, but production is dispersed to satisfy the unique needs of local markets and to take advantage of geographical variations in factor endowments and business environment (e.g., labor supply, energy resources, university consultants, etc.). Global production systems are designed from the perspective that the whole earth (and, indeed, outer space) is at least potentially a production site.

This trend toward transnationalization affects knowledge production, which is shaped according to the needs of transnational corporations. In the case of Latin America, the globalization of knowledge production can be dated to the early 1960s, when resources and institutional models were exported from the core (perhaps best symbolized by the U.S. Alliance for Progress with the principal Latin American countries) to incorporate Latin American universities into a new transnational system of power and knowledge production (Briceño 1988). The nation-state is not a dependent variable in these developments, however. Quite the contrary, the interaction of national and global forces generates unique outcomes in most cases, including the one before us. But the character of those interactions is different when the social units engaged in it are not exclusively bounded by the nation-state, as is the case when production is organized on a global basis. The fundamental change here is that capital has created concrete organizational forms that are global in character (the transnational corporation), whereas the nation-state continues to be territorially bounded. Although these changes are often cast in the benevolent ethos of "internationalization" (e.g., of trade and commerce, or the humanitarian collaboration of scientists beyond the parochial bounds of national interest), we suggest that, in both material and normative terms, the issues are far more complex.

The Mexican Context

In Mexico, globalization is taking place in the form of rapid integration into a North American economy. This process is driven not only by global economic trends but by the declining political hegemony of an autocracy (represented by the Partido Revolucionario Institucional, PRI) that has ruled the country for over six decades and that looks to this integration as the fastest way to an economic recovery that might restore political stability. However,

as the autocracy becomes increasingly isolated and is challenged by social movements, its efforts to modernize through attempts to induce the transnational corporations into joint ventures that use Mexican resources and scientific human power are accompanied by a reversion to the most archaic and backward political practices. These include fraud and corruption, which are traditional practices that have expanded during recent electoral contests (Riding 1985), as well as the spread of repression into areas previously untouched by it, such as the scientific and technical communities.

Following several decades of rebellion, civil war, and ultimate accommodation to the interests of foreign and domestic capital during the regime of President Lázaro Cárdenas (1934-40), Mexico experienced rapid industrialization and economic growth from the 1940s through the 1970s.[2] This helped maintain PRI's political hegemony in spite of an extremely unequal distribution of income and wealth and the concomitant dislocations and social mobilizations that accompany rapid industrialization.[3]

In addition to growth, several other characteristics of PRI's rule have contributed to its longevity. First, the government has exercised near-total control over most unions since the 1940s under a system known as *charrismo*, which deploys favoritism and corruption to buy off union leaders (Cockroft 1983, 155). Second, electoral fraud has been routinely used to ensure the victory of PRI candidates for the national Chamber of Deputies, governorships, state legislatures, and municipal mayoralties throughout its history (Riding 1985, 68). Third, PRI has carried forth a nationalist project launched by the revolution of 1910-20 that resonates with popular sentiments shaped by a history of foreign intervention and proximity to "the Colossus to the North." As often as not, this nationalism has taken the form of a rhetorical cover for substantive injustices that PRI governments or the autocracy have either tolerated or imposed. Nonetheless, there is a substantive side to nationalist policy in modern Mexico dating at least to 1917, when legislation regulating foreign investment was promulgated (this preceded parallel enactments in other Latin American countries by more than three decades [Correa 1986, 38]).

The final characteristic of PRI's rule has been repression, which has been consistently used when the other means of maintaining hegemony have faltered. For example, when the rail workers voted in 1958 to disaffiliate their union from the official union and sparked a wave of strikes, the government responded by jailing its leaders, Demetric Vallejo and Valentin Campa, for 13 years.

Massacres of between a dozen and several hundred followers of opposition presidential candidates occurred during electoral campaigns in 1927, 1929, 1940, 1946, and 1952. This propensity for political violence received

international attention in 1968, when the police responded to student protests of political repression by beating high school students who had barricaded themselves in a campus building in Mexico City. This act galvanized middle-class support for what had been a student and leftist movement, with crowds of up to 300,000 turning out for rallies and marches in July and August. The crisis culminated at the Plaza de Tlatelolco in Mexico City on 2 October, just 10 days prior to the start of the Olympic Games being held in that city, when police and soldiers attacked a public meeting, killing hundreds of protesters and bystanders[4] (estimates vary from 200 to 500; Riding 1985, 59-60; Cockroft 1983, 241).

The Tlatelolco massacre rekindled a wave in an era of violent repression (torture, murder, disappearances) against groups posing a threat to PRI's political monopoly that continues to the present. The primary victims have been peasants and leftist guerrillas in the countryside, but urban workers and professionals have been targeted as well. In the late 1980s, for example, attempts to break the government's control over the schoolteachers' union resulted in the assassination of several dozen dissident activists. During the six years of the Miguel de la Madrid presidency (1982-88), some 30 journalists were assassinated, including the very prominent Manuel Buendia. Very few of these cases have been solved.

The new repression has appeared in the electoral process as well. PRI suffered a spate of defeats in northern municipal elections in the 1980s, as well as the first losses in provincial governorships of the party's history. Electoral fraud, traditionally limited to local elections, has spread to national elections, amid widespread allegations and substantial evidence that PRI's 1988 presidential victory was rigged (Barberán et al. 1988; Schoijet 1991b). PRI's loss of legitimacy has elicited severe repression, with more than 100 members of the leading opposition party headed by Cuauthémoc Cárdenas killed in conflicts over local elections in the last few years (Ramirez 1990).

The proximate cause of Mexico's deepening crisis was the fall of oil prices in 1981, which undercut the capacity to repay a spiraling foreign indebtedness accrued through a capital imports boom in the 1970s. The crisis deprived PRI of the growth proceeds that it has traditionally used to buy the acquiescence of disparate social interests, which share little other than their acceptance of PRI hegemony. As a result, PRI has abandoned its nationalist development strategy in favor of the neoliberal policies pursued by the governments of Miguel de la Madrid and Carlos Salinas de Gortari (including the free-trade agreement that awaits congressional action as we go to press). This shift in policy is quite visible in the research system, where government initiatives since the mid-1980s have generated considerable controversy. Both the direction of these changes and the larger political-economic context

have ominous implications for the integrity of the scientific enterprise in the new era of global production.

Restructuring and Nationalism in the Research System

As Mexico's political-economic crisis deepened in the 1980s, the research system experienced loss of autonomy to centralized government control, closure of research institutes, and harassment of dissident scientists. With these changes, a pattern of discrimination emerged against social scientists, leftists, the foreign born, and those with research specialties in areas lacking immediate commercial application or characterized by positions either critical or tolerant of government policies. This deepened the gulf separating the undergraduate teaching institutions from the research institutes and graduate schools.

A prominent casualty of the 1980s was the Consejo Nacional de Ciencia y Tecnologia (CONACYT). CONACYT had been formed in 1970 to promote the development of indigenous scientific and technological resources as a means of breaking technological dependency on the core powers and transnational corporations.[5] The means for accomplishing this included the creation of new research institutes, forging better linkages between researchers and industry, and providing student fellowships for study in scientific fields at home and abroad (about 30,000 fellowships were awarded in the first two decades of CONACYT's existence).

CONACYT emerged from a larger political strategy that combined a revived populism with a new emphasis on technocracy. President Luis Echeverría (1970-76) was the first career bureaucrat to ascend to the presidency, having spent his entire career in Mexico City rather than coming up through local and provincial elections. The new investment in science and technology for national development served the interests of the growing legions of technocrats required to manage Mexico's rapidly industrializing society, and the rhetoric of technological autonomy helped revive PRI's populist credentials in the wake of the Tlatelolco massacre. Echeverría's opening to the intelligentsia was symbolized in the case of science policy by the inclusion of scholars associated with opposition political parties in the planning and advisory bodies of CONACYT.

Combining nationalism and science policy, however, turned out to be easier said than done. Most graduate students sent abroad for study in physics and mathematics, for example, failed to return to Mexico on completing their studies, partly because the economic crisis and salary reductions for researchers reduced their opportunities (Prieto de Castro 1991). Notwithstanding

improved salaries, creation of new research institutions and a "brain drain" to Mexico occasioned by the emergence of brutal dictatorships in Argentina, Chile, and Uruguay, the results of CONACYT's first decade of activity were modest. By the early 1980s, Mexico remained behind such countries as Chile, Jamaica, Trinidad, Argentina, Costa Rica, Venezuela, Uruguay, and Brazil in scientific output per person.[6]

The modest momentum of the 1970s was stopped in its tracks by the economic crisis, as the de la Madrid government imposed austerity programs that meant a sharp reduction of professorial salaries and graduate fellowships. A key element of this retrenchment was a deprofessionalization policy at the universities that reversed the previous trend of hiring full-time professors but maintained the salaries of top officials—rectors, directors, department chairpersons, and administrative officials. Indeed, some of the corrupt practices of the government bureaucracy, such as secret payments in the form of "performance bonuses," migrated to higher education during this period.

Also during this period, CONACYT lost its institutional autonomy and was placed in the Secretariat for Planning and Budget. The immediate effect was a no-growth budget that was ravaged by inflation in the range of 100% during 1986 and a two-thirds reduction in the number of graduate fellowships. CONACYT has now come full circle. Ostensibly created to break the chains of technological dependency, CONACYT is currently selling off many of the very research institutions deemed necessary for national independence less than 20 years ago (Tangemann 1991) and financing "research centers" in which budgets, projects, and results are proprietary information. Apparently, the main beneficiaries of the latter projects are enterprises such as Ericsson, IBM, and Nestlé (Schoijet 1991a, 117-18).

At the same time that CONACYT's autonomy and resources were cut, the de la Madrid government created the Sistema Nacional de Investigadores (SNI) to mitigate the problem of declining salaries for academic researchers. SNI provides a salary supplement that varies between approximately 50% and 100% of most base salaries. More than 4,000 researchers have been accepted into the system since its founding in 1985. Although the SNI represents an improvement for a respectable group of scholars, both its conception and operation have been heavily criticized.

Institutionally, the system reinforces elitism within the scholarly community by requiring that applicants be able to devote at least 35 hours per week to research. Under the Mexican system, which assigns research functions to one set of institutions and teaching responsibilities to another, the majority of the country's professors are virtually excluded from SNI. Although accurate figures are hard to come by, the total number of full-time personnel engaged in teaching or research in Mexico probably is in the 15,000-20,000

range (Schoijet 1988, 5; Worthington 1987, 34), which means that only 20% to 30% have been accepted to SNI.

Income received from SNI is classified as a fellowship rather than a salary. Because it is not a salary, SNI compensation is not taken into account for retirement. Moreover, the terms of this fellowship make it an ideal means for exerting state control over the intelligentsia. Although the fellowship can be held for 30 years, every 3 years it is subject to a review in which recipients can be moved to a lower level of compensation or dismissed from the system altogether, with no right of appeal.

The selection committees that make these decisions are appointed by a government agency (Secretaría de Educación Pública), with the exception of a statutory place for the rather conservative, progovernment Academia de la Investigación Científica.[7] Only one of the selection committees (in the biological sciences) has published substantive criteria for appointment. There are four levels of appointment for those admitted to SNI (one junior and three senior), but levels of appointment are not published. In sum, the universities, professional associations, and scientific societies lack significant control over SNI decision making, reserving it instead for progovernment forces, which keep the results secret. The contrast with the broad-based participation in CONACYT in its early days is instructive of the changes taking place in Mexico.

To date, the selection committees in the natural sciences and medicine have generated little controversy. Most commentary in the natural sciences has focused on SNI itself, rather than the particular decisions of selection committees (Schoijet 1991a). However, the design deficiencies in SNI have been made particularly evident by the practices of the SNI Commission on Social Sciences and Humanities.

The first two selection committees in the social sciences and humanities, which operated from 1984 to 1990, had no clear rules, and its two economists, Victor Urquidi and Leopoldo Solis, were associated with the government, the latter as chief economic adviser to President de la Madrid. Solis's appointment to this committee might have violated the regulations that require that SNI members be active researchers in academic institutions—committee members being automatically appointed as highest-category SNI members. Obviously, the presidency is not an academic institution, although it might hire some advisers of past scholarly achievements. As far as we know, the procedures of the current selection committee are equally vague. The most notable change is that SNI has stopped publishing the names of committee members.

The partisan bias of this committee brought predictable consequences, as can be seen in the case of economists. Divisions were sharp within the

Mexican economics community, and most academic economists oppose government economic policies. The appointments of Urquidi and Solis to the selection committee thus discouraged many economists from applying. For example, at the Instituto de Investigaciones Económicas of the Universidad Nacional Autonoma de México (UNAM), which employs more than 100 researchers, only 4 applied, of whom 3 were rejected. In a telling case, Juan Castaings of the Universidad Autonoma Metropolitana (UAM)-Ixtalpa was rejected, despite winning the prize given every four years by the UAM system for the best research in social sciences. (Castaings was later accepted at the lowest SNI level after widespread protests of initial results, but removed after his three-year review.) Overall, the social sciences committee of the SNI rejected a higher proportion of applicants than the other committees, and a very qualified political scientist told one of us in an interview that the committee not only rejected some of the best political scientists but displayed favoritism toward some less qualified. Among those rejected were well-known intellectuals, such as philosopher Enrique Dussel, historian Adolfo Gilly, economist David Barkin, and political scientists Agustin Cueva and John Saxe-Fernandez (Dussel and Barkin were later reconsidered).

To test the discriminatory potential of SNI further, we compiled a list of the 49 most cited Mexican scholars in the social sciences and humanities for the period 1981-86, using data published in the *Social Sciences Citation Index* (SSCI). Inclusion on this list was based on having a larger number of citations in SSCI than the average number of citations for selection committee members (18).[8] An analysis was then conducted of the status of these scholars in SNI, using the published list of appointees and compiling information on the others from UNAM and UAM sources, as well as direct interviews. The results of this analysis are contained in Table 1.

Three things are immediately apparent in the data. First, foreign-born scholars (either naturalized citizens or resident foreigners) are disproportionately represented, accounting for 23 of the 49 people on the list. All of those who have been rejected by SNI are foreign born, and the appointment levels of naturalized and resident foreigners who have been accepted are markedly lower than those of native Mexicans.

The irony here is worth contemplating. CONACYT encountered difficulty securing the return to Mexico of fellowship recipients sent abroad for scientific study, indicating the limited capability of a peripheral power to avail itself of external resources in national development. SNI's discriminatory practices, on the other hand, encourage through state policy the dissolution of the national patrimony represented by a history of migration by intellectuals to Mexico.[9] Only 3 of 27 members on SNI selection committees (1984-87) were foreign born, and committee members are automatically

Table 1. Sistema Nacional de Investigadores (SNI) Status of Most-Cited Mexican Scholars in Social Sciences and Humanities ($N = 49$)

SNI status	*Foreign born (23)*	*Native (26)*
Not eligible	1	2
Did not apply	2	3[a]
Applied	20	20
Accepted	12	20
Colegio and research institutes[b]	12	16
Rejected[c]	8	0
FCP-UNAM or UAM[d]	8	0
Level of appointment ($N = 17$)		
High	1	8
Intermediate	5	1
Low	2	0

a. One additional scholar on the list is believed to have not applied, but this could not be confirmed. Three of the four who did not apply hold appointments at the Instituto de Investigaciones Economicas or the Facultad de Ciencias Políticas of the Universidad Nacional Autonoma de México (UNAM), which include many critics of government policy among their faculty.
b. Includes those holding appointments at Colegio de México, UNAM and provincial research institutes, plus one employee of the presidency. Most (but not all) faculty are conservative or progovernment.
c. Three were later accepted, and one of those accepted was later eliminated.
d. FCP-UNAM is UNAM Facultad de Ciencias Polítcas (see note a); UAM is Universidad Autonoma Metropolitana. Both are primarily engaged in undergraduate teaching.

appointed to the highest category in the system. It would thus appear that Mexico's earlier nationalism in development strategy and science policy, which aimed to build up the nation's industrial infrastructure and research system, has been superseded by a retrograde nationalism that distributes declining resources to a self-serving elite of progovernment elements. The contrast with the "internationalist" ethos of science often associated with globalization suggests that the progressive rhetoric of neoliberal policy merits close scrutiny.

A second insight provided by the data is that most of those who chose not to apply to SNI hold appointments at institutions that are tolerant of ideological diversity and include outspoken critics of government policy among their faculties. Moreover, all of those rejected are at either the school of political science of UNAM or the social science divisions of UAM, both of which include a fair number of leftists. On the other hand, all of the foreign born

accepted to SNI hold appointments at the more conservative Colegio de México (which offers only graduate instruction) and various UNAM and provincial research institutes, showing that institutional discrimination is also at work in SNI decision making.

Finally, the results show that the class structure within the research system is actively reinforced by SNI. Notwithstanding the SNI requirement that 35 hours per week be devoted to research, 12 of the 48 scholars on the most-cited list hold faculty posts at undergraduate teaching institutions (UNAM and UAM). Nonetheless, all of those rejected are faculty at such institutions.

Given these immediate effects of SNI, a recent evaluation of some 700 graduate programs by CONACYT comes as no surprise (Yacaman 1991a, 1991b). This three-month study (the full results of which have yet to be published) approved 165 of the programs, placed 106 in a conditional category, and disapproved 413, meaning that they will no longer be eligible for CONACYT fellowships. Membership in SNI of the faculty of these programs was one of the criteria for determining their quality. As might be expected, graduate programs in economics at UNAM and UAM were not approved, whereas the *colegio* and other less critical programs were approved. Also rejected by the evaluation were the environmental studies program at the Instituto Politécnico Nacional and graduate programs in political science at UNAM and social medicine at UAM-Xochimilcho. At the same time, the SNI model has been adopted internally by both UNAM and UAM, where salary increases have been displaced by bonuses for a small minority—under 2% of the professors at the UAM, even less at the UNAM. In short, a neoliberal approach to knowledge production is being institutionalized.

One proximate factor contributing to these developments is the weak organization of Mexico's intellectuals, especially those in the social sciences. Professional organizations of economists and political scientists, for example, represent government workers and do not function as scholarly societies. The Academia de la Investigación Científica, which includes several hundred natural scientists, has only a few dozen in the social sciences and has exhibited little professional autonomy (see note 7).

This weak organization of the intelligentsia was perhaps less crucial prior to 1982, when economic expansion and the nationalist ideology provided both financial means and political space for critical intellectuals. In an environment of global restructuring and domestic retrenchment, however, the narrow social base of the intelligentsia has meant that the autocracy can treat intellectuals like any other component of the unorganized labor force.

Given a powerless intelligentsia and a domestic state committed to attracting foreign capital, policies aimed at increasing the productivity of the

research system almost invariably have direct political implications. For example, the requirement of annual publication reports for evaluation committees has discouraged more ambitious projects in favor of publishing short articles (Araujo 1990). This fragmentation of knowledge production further undermines the collective power of intellectual producers while conferring advantage on those (principally in transnational corporations and the state) who appropriate knowledge for profit and control. In sum, neoliberal research policy has generated self-censorship, fragmentation, and structural subordination of the intelligentsia.

Repression in the Research System

The foregoing changes in research policy and management have restructured scientific inquiry in Mexico by changing rules and incentives. During the same period, a pattern of repressive actions against institutions and individuals has emerged that reflects the same drives toward privatization, profit, and authoritarian control of knowledge production. The government's intolerance of research on environmental and energy issues that might place the neoliberal growth model in a negative light is especially evident in these cases.

One victim of closure was the Instituto para Investigaciones en Recursos Bióticas (INIREB), which had been created in 1975. As one of the few research institutions outside the Mexico City area, it had some 80 researchers. INIREB's environmental pollution research group was distinguished in the Latin American biological sciences community and was virtually the only one in Mexico doing field research in heavy metals and pesticide contamination. *Biótica* magazine, published by INIREB, was one of the most important in Spanish dealing with biological resources. INIREB's master's program had granted some 50 degrees, while some 60 students were in the program in 1986, including many from other Latin American countries.

At the beginning of 1988, the *junta directiva* (equivalent to a board of trustees, composed mostly of high government officials) rejected the annual activities report. The reasons were never disclosed, and, after a process carried out under the cloak of secrecy, the INIREB was closed down in November 1988 by a federal government decree that cited the need for a better use of financial resources. The students were left to their own luck, and the installations were transferred to the Instituto de Ecologia, a smaller private institution located in Mexico City. About 20 of the less qualified researchers were hired by the latter organization to study commercial mushroom agriculture and pursue other applied projects. Dr. Lilia Albert, probably

the best-known environmental toxicologist in Mexico, who had been the chief of the environmental contamination group, was hired by the Centro de Ecodesarrollo, a smaller government-supported research institution in Mexico City. She was promised funds for starting a laboratory, but they never materialized, leaving her to carry out bibliographic work.

Another program hit by retrenchment was the Energy Studies Program at the Colegio de México. It was closed down in 1988 without any explanation, and its researchers were dismissed, with the exception of one who was transferred to another group. Mr. Mario Ojeda, director of the *colegio*, said in an interview given several months later that the group did not meet the institution's standards, but the program had published five books in its last year and attracted funding from international organizations, such as the European Economic Community. Given the lack of an open review, the broader move against energy and environmental studies, and these apparent accomplishments of the program, Ojeda's explanation lacks credibility. The *colegio* also extinguished programs in environmental studies and women's studies through attrition, again without explanation.

Also affected during this period were the Colegio de Agricultura Tropical, a small agricultural college located in the southeastern state of Tabasco, which was closed down by the government in 1982, and the Proyecto Lázaro Cárdenas of the School of Political Science at UNAM, a research group in the field of energy and nonrenewable resources, led by the already-mentioned Dr. John Saxe-Fernandez, which was pushed to the edge of extinction by the withdrawal of government funding.

Starting in 1988, a parallel pattern of repression against individual scientists and engineers emerged, mostly at the Comisión Federal de Electricidad (CFE) and at the closely connected Instituto de Investigaciones Eléctricas (IIE), located near Cuernavaca, south of Mexico City.

Several scientists and engineers of the *instituto* were dismissed in March 1988 for demanding an increase of salaries and participation in decision making. In August, several engineers and geologists were also dismissed from the Geothermal Division of the CFE, located in Morélia, in the western state of Michoacan. One of them, Mr. Rene Canul, was the founder and first editor of the *Revista de Geotérmia*, the only publication on geothermal energy in a less developed country of which we are aware. They were dismissed for refusing to comply with a union directive to attend meetings of the ruling party and for demanding an increase in salaries.

Dr. Victor H. Garduño, a geologist working at the same division, was dismissed in October of the same year. The cause of his dismissal was related to the issue of nuclear power. The first Mexican nuclear plant is located in Laguna Verde. This area, in the state of Veracruz, displays seismic and

volcanic activity, a fact with obvious implications for the plant's safety. The debate on the safety issue involved several sectors of the Mexican scientific community, including the geologists. In October 1988, there was a biennial meeting of the Sociedad Geológica Mexicana that heard a report on the geological conditions of the Laguna Verde area, which represented the official point of view, minimizing the dangers. The speaker was closely questioned by more than 20 participants, including Dr. Garduño, who was dismissed a few days later, with the explanation that by questioning the report he became guilty of disloyalty.

In April 1989, the CFE dismissed Mr. Raul Alvarez Garin, a physicist who had worked for 15 years in its computing center in Mexico City. The reasons have not been clarified, but it is worth noting that Mr. Alvarez is active in the Partido de la Revolución Democrática, which poses a threat to PRI hegemony. In many cases, those dismissed from the INIREB, CFE, and IIE have either given up research and turned toward other activities or emigrated.

Jesus Arias Chávez, a physicist and professor of the Instituto Politécnico Nacional for 25 years, was dismissed in May 1989. In the early 1970s, Mr. Arias Chávez had founded the Fundación Xochicalli, at Ozumba, some forty kilometers from Mexico City, which promoted soft technologies, especially biological digesters. The foundation had laboratories, workshops, and an important library, together worth several hundred thousand dollars. A large part of this money came from funds donated by Arias Chávez himself, who had acted as a consultant for several Latin American and international agencies. He is also an antinuclear activist. In September 1988, the workshops and laboratories were destroyed by a fire. Police investigators told Arias Chávez that the fire had been intentional and the work of well-trained criminals. They were never found. After this, Arias Chávez was denounced by paid insertions in the press as an agitator (which he denies), in a case involving the forced removal of squatters in an area south of Mexico City. After several harassment measures, he was finally dismissed. He is fighting his dismissal in a court action.

One of us (Schoijet) teaches at the Departmento el Hombre y su Ambiente (Man and Environment) of the Xochimilcho campus at the Universidad Autonoma Metropolitana and is among the small number of scholars in Mexico interested in energy studies, as well as a known and visible opponent of nuclear power. In recent years, several professors in this department have been steadily harassed by the UAM authorities. Dr. Manuel Servin Massieu, a biochemist, one of the founding professors of the UAM, resigned as a result of this harassment. About the end of 1988, Schoijet was accused of unjustified absence for attending a meeting of the Society for Social Studies of Science.

The authorities started dismissal proceedings shortly thereafter. In December 1990, the authorities dissolved the research group that included Ms. Maria Antonieta Aguayo, Dr. Antonio Flores Diaz, and Schoijet, an action without precedent in 10 years of institutionalized research areas at UAM-Xochimilcho.

Finally, three UNAM professors who are also free-lance journalists have been intimidated in the past two years. Two of them—Mr. Adolfo Aguilar Zinser of the Centro de Estudios sobre Estados Unidos and Dr. Raul Cremoux of the school of political science—were kidnapped. In the third case, the secretary of Dr. Jorge Castaneda from the economics department was kidnapped. In all three cases, the kidnappers conveyed the message that the professors should cease criticizing the government.

The various actions against academics and researchers described in this section pose an interesting contrast with the repression experienced by researchers in the wake of the Tlatelolco massacre and in earlier episodes. After Tlatelolco, philosopher and science historian Eli de Gortari and civil engineer Heberto Castillo were imprisoned (the latter headed a militant opposition party that spurned PRI's efforts to buy it off); biologist Manuel Gutierrez Vasquez was fired; and mathematician Marcelino Perello was forced into exile.

Eli de Gortari had also been forced in 1963 from his position as rector of the Universidad Autonoma San Nicolas de Hidalgo, located at Morélia in the state of Michoacan; the campus and the city were subsequently occupied by army troops. In 1966, fascist gangs, supported by the conservative business community of Puebla, attacked and destroyed the laboratories and the library of the School of Sciences of the Universidad Autonoma de Puebla, forcing several professors, including the well-known physicist Dr. Leopoldo Garcia Colin, to leave the university and the state.

In short, repression at academic institutions in Mexico is not new, but some distinctions are worth noting. First, the Morélia and Puebla cases occurred in regional centers. Although it remains unclear whether or not federal officials encouraged the local reactionaries, there is no overt evidence of direct federal orchestration of repression. Second, the post-Tlatelolco repression occurred at a time of peasant land seizures, guerrilla operations, and worker militancy and, thus, came as part of a reaction to militant mass mobilization rather than electoral mobilization. Finally, the number of individuals directly affected has been substantially greater in the past seven years than in the earlier cases. In summary, the systemic controls imposed on academics by the state in recent years are more sophisticated in that expanded direct actions against individuals are being complemented by institutional

mechanisms that fragment the academic and research communities. Preemptive repression has begun to supersede the reactive variety even as the latter is more actively deployed.

Both local and global factors seem to be at work here. First, it was during the 1970s that Echeverría courted the intelligentsia and technocrats in a bid to legitimize his rule, which no doubt constrained any repressive tendencies that might otherwise have surfaced. But with raised expectations now dashed by the collapse of nationalist policy, these same groups have encountered the repressive tactics long deployed by PRI to control workers and social movements.

Second, academics are, if anything, even more important producers under conditions of high-technology global production than they were during earlier phases of industrialization. They train the technocrats and provide the expertise required by industry, and they must do so to satisfy transnational norms in labor markets. As we have seen in the case of the United States, this involves assigning knowledge workers to problem areas relevant to corporate and military needs (Dickson 1984) and is accompanied by a technocratic and antiworker ideology that can be harsh on dissenters (Black and Worthington 1988; Saxenian 1988). Both of these processes seem to be operating in the Mexican case as well.

Global Change

Much of what we have discussed can be explained in terms of political developments within Mexico. For example, actions such as the firing of Garduño by the CFE bear the distinctive markings of *charrismo* and the arrogance of an inflexible public bureaucracy, attitudes that are deeply ingrained in Mexican politics and culture. Likewise, the predatory practices of the autocracy's minions in the SNI are perhaps typical of monopoly parties in a process of decay.

But we would argue that these events are also connected with the transnationalization of science and industry that, in the case of Mexico, is bolstered by U.S. hegemony. Unlike previous cases of repression of scientists (e.g., the United States during the McCarthy era, the expulsion of scientists from Nazi Germany, Lysenko biology in the Soviet Union, Brazilian and Argentinian scientists in the 1960s and 1970s), anti-intellectualism, political extremism, and state ideology are not major factors in the Mexican case. As we have already indicated, the precipitating events are instead the collapse of the growth economy of the 1970s and, more generally, the reintegration of Mexico into a transnational system. This restructuring is changing the role

of scientists in Mexico and other peripheral countries, to the benefit of some and the detriment of others.

Three global trends set the Mexican case apart from earlier episodes of repression of scientists in other countries. The first is the heightened mobility of industrial products and the primary factors of production—capital, labor, and ideas. Although this new mobility has done little to alter the hierarchical structure of the global economy, it has facilitated the relocation of sophisticated components of a vertically integrated global production system in countries such as Mexico without sacrificing control by transnational enterprises based in the core countries. Inevitably, this industrialization, as well as the continuous reconfiguration of production that has accompanied its emergence as a global system, has required the mobilization of increased scientific and technological expertise at or near Third World production sites. This stands in stark contrast with the minimal expertise needed in earlier phases of industrialization, when countries like Mexico survived on a combination of subsistence agriculture (with some more-developed agricultural enclaves), light industry, and the export of primary commodities (including labor), semimanufactured inputs for foreign industry, and simple manufactures.

Second, science and industry are themselves being reconfigured. As science-based industry grows, the distinction between basic and applied science is blurred, and knowledge production is increasingly monitored by academic, government, and corporate managers for its profit potential. University-industry research consortia are one example of institutional innovations designed to increase the profitability of scientific research. At the same time, issue-based groups ranging from animal rights advocates to farm workers and opponents of abortion increasingly seek to influence scientific research in accord with their social and political objectives (Wheeler 1990). Although their values are often at odds with those of the industrial elite, the common element is a heightened scrutiny of science around the world that yields increased competition for control over its processes and outputs.

Finally, labor (including scientists and engineers) is increasingly deployed on a flexible basis. Corporate downsizing, outsourcing, retooling, "informal" employment, and mass migration are all manifestations of a labor market in which skill requirements as well as the location, organization, and demand for work are subject to continuous change (Sassen 1989). One practical consequence of this is the decline of unionized labor in the core countries, which had been institutionalized earlier in the century by harmonizing labor's interest in collective bargaining and employment security with management's need for a disciplined labor force. Deunionization has been accompanied by a rise in relatively secure "knowledge workers" and the assembly of a global army of "unprotected workers" (Cox 1987; Godfrey 1986) who

perform the many low-wage, high-risk, dead-end tasks that are an inherent feature of the global economy as it is currently designed.

Third World scientists and engineers, although small in number, are a pivotal group in these changes. Many will benefit greatly from the increased demand for their services, but those who resist the larger trajectory of global capitalism may find that their relatively privileged status affords inadequate protection against exploitation and repression. In other words, this group may be simultaneously affected by the increased status and power conferred by its new role in global production, on the one hand, and proletarianization, on the other.

We noted above that economic-structural factors are dominant in Mexican repression of scientists, whereas political-ideological factors are salient in a number of other 20th-century examples. The Mexican case contrasts with earlier economic-structural shifts as well. A case in point is the transition from a rural-agricultural to an urban-industrial economy in the United States during the late 19th and early 20th centuries. It was during this transition that science was transformed from a primarily avocational to a professional pursuit. A critical element in this shift involved harnessing science and scientists to the interests of large corporations and the military (Noble 1977). Nonetheless, this profound change occurred with minimal displacement of established scientific professionals, in part because it was during this shift that science first became a professional activity.[10] There was substantial conflict over what science would become at this time, but those displaced by the transformation were "cultivators" of science rather than professionals, and the growth in number of professionals created by the transformation dwarfed the displacement of cultivators (Carroll 1986; Reingold 1976).

Three things are different today. First, science is now an established profession pursued by millions of people on a worldwide basis. Second, as science is increasingly viewed as a "cost-center" and a "productive asset," a more obvious class structure that exploits graduate students and marginal scientists (a permanent underclass of fully certified but institutionally insecure researchers) has emerged in scientific production (Hackett 1990). Finally, the earlier rural-to-urban shift was largely contained within national societies. The current globalization of production, on the other hand, introduces *inter*national inequality into a restructuring process that affects an established and entrenched profession. In the first shift, then, there was enormous expansion of opportunity for science and scientists and relatively little displacement or repression. In the current shift, the opportunities are less expansive, whereas structural exploitation and displacement of scientific professionals has itself become an enduring feature of the research system.

The developments described here suggest that these trends should be viewed at a *supra*national level, as well as within nations.

What we have seen in Mexico is the failure of the regime's attempt to mobilize science and technology for nationally based economic development. The subsequent demobilization and reorganization of the research system to more effectively serve the interests of global capital marginalized researchers and academics whose work was relevant to a more broadly based model of ecologically sustainable development or was otherwise outside the control of the PRI autocracy and victimized many who were simply in the wrong institutions. Politically, this restructuring has been managed by the same autocracy that earlier promoted the nationalist model and that now sees neoliberalism as the best means of maintaining its hegemony. The increasingly predatory character of the autocracy, however, may deliver the worst of neoliberalism and nationalism, that is, both subjugation to the interests of global capital rather than self-sustaining economic development and retrograde nationalism that limits the vitality of the research system.

Notes

1. The research system is composed of institutions of higher education and research, including private companies and other organizations that use research in commercial and other applications. Our focus in this essay is on higher education and academic research. In Mexico, nearly all of these institutions are public. The four main components are research institutes of the Universidad Autonoma de México (UNAM) and various provincial research institutes; the *Colegio de México*, devoted to graduate studies; the various schools of UNAM that deliver undergraduate instruction; and the Universidad Autonoma Metropolitana (UAM), which also provides mostly undergraduate instruction. Commercial research has traditionally been weak, although its importance is growing, as described in this article and in Worthington (1987).

2. In 1930, Mexico was inhabited by 16.7 million people. Two-thirds of the population lived in settlements of fewer than 2,500 people, most of whom were engaged in mining and subsistence agriculture. Today, more than two-thirds of the population lives in settlements of greater than 10,000 people, and the per capita gross national product (GNP) has risen to $2,080 (1985). Output increased seven times in the period from 1930 to 1980. Among the more industrialized Latin American nations, only Brazil maintained a higher GNP growth rate in the two decades from 1965 through 1985, notwithstanding the downturn in Mexico after the fall of oil prices in 1982 (Wionczek 1986, 550-51). Although the corporatist state established during the 1930s played a central role in promoting this growth (accounting for more than 40% of total investment in every decade but the 1950s), it became progressively more dependent on foreign capital for investment and technology, culminating in the debt crisis of the 1980s (Cockroft 1983, 161 and *passim*).

3. Cockroft (1983, 2-3) notes that one-half the population receives 13% of Mexico's annual income, whereas the wealthiest 10% receive one-half of the income. Between 1958 and 1977—the heart of the growth boom—income for the top 5% of the population increased from 22 to 47 times that of the bottom 10%.

4. The repressive side of nationalist ideology is exquisitely portrayed in the comment of President Gustavo Diaz Ordaz in early September (six weeks before the start of the Olympics) that the protests would be put down "to avoid any further loss of prestige" (Riding 1985, 59).

5. Although this was somewhat later than in the other major countries in the region, which had created similar institutions in the 1950s and 1960s, CONACYT's antecedent organization, founded in 1935, was well ahead of its time (Organization of American States 1984).

6. Data on scientific output reported in Braun, Glanzel, and Schubert (1987) for 1978-80 were calculated on the basis of 1980 population for each country. For a fuller discussion of Mexican science and technology infrastructure vis-à-vis other Latin American countries, see Worthington (1987).

7. The *academia*'s opportunism and subservience to state power were perhaps most clearly signaled by its public backing of Lopez Portillo's nationalization of the banks in 1982 (only Mexican banks were affected, and they were reprivatized shortly thereafter) and its conspicuous silence through a long period of reductions of faculty salaries and graduate fellowships during the 1980s.

8. The usefulness of citations as an indicator of scholarly productivity is a controversial matter. In using citations to examine SNI decisions, we are following SNI criteria that require citations on application forms and, in the case of biological sciences, require a minimum number of citations for appointment to the higher levels.

9. A milestone in the development of Mexican science was the creation in 1941 of what later became the Institute for Research in Biomedical Sciences at UNAM, which was staffed in part by refugees from the Spanish Civil War who had worked with the group originally headed by the Nobel Prize recipient Ramon y Cajal (Lomnitz 1979).

10. Interestingly, the greatest controversies within academic disciplines over their relationships with the wider sources of power and wealth in American society occurred in the fledgling social sciences. Both political science and economics, for example, received their initial impetus during the late 19th century from social reformers (often reflecting a humanistic Christian sense of social responsibility). By the early decades of the 20th century, however, both fields had developed a leadership that was willing to abandon pretensions to a social reform agenda in exchange for professional autonomy from "outside" political influence (Worthington 1990).

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