*The dramatic contrasts in opinion about the effects of international scientific migration are traced to its intrinsic character as a polymorphic, recurrent phenomenon whose costs and benefits have never been successfully evaluated. The tendency to assign countries the status of "winner" or "loser" in migration patterns is shown to be of dubious usefulness in an era of changing economic paradigms and increased interconnection of scientists via electronic communication networks. Nevertheless, those countries with neither improving economies nor easy and inexpensive network connections may still find themselves at a disadvantage in the global flow of scientific talent.*

# *The International Circulation of Scientists and Technologists*

## *A Win-Lose or Win-Win Situation?*

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### *Winners and Losers*

The debate on unemployment in France during the last few months has attracted swarms of more or less well-orchestrated newspaper articles and radio/television broadcasts discussing the "hemorrhage" of French minds to the United States.[1] These articles and broadcasts have not only put the spotlight on famous French scientists who have crossed the ocean and been welcomed with open arms in the United States but also on the exodus of French post-docs who, after graduating from American universities, cannot find a job in France which matches their academic level.[2] Paradoxically, other journalists, via these same media, report that, of all the European Union countries, France has the lowest percentage of working population which leaves home.[3]

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The debate on international scientific migration (ISM) purports different, even opposite arguments, depending on the time, the place, and the point of view.[4] Thus, there are voices these days to express regret that despite repeated promises to become more open, Japanese academic and research organizations run an "intellectual closed shop." On one hand, foreign scientists are kept out of Japan's laboratories, and foreign teachers and scholars are dismissed from Japan's national and private universities,[5] while on the other hand, the country continues to send its professors, engineers, and physicians to the best universities and research centers in the United States (Hall 1998). In sum, Japan readily sends its intellectuals abroad and, at the same time, practices intellectual protectionism at home because the ISM phenomenon is viewed in a manner that is diametrically opposite to the generally accepted viewpoint. Japan considers the emigration of its scientists as a "national extension," as an "S&T [science and technology] watch"; in other words, as a source of gain, and conversely, quite logically, often views the presence of foreign scientists in Japan as a potential risk.

In the United Kingdom, ISM is also again becoming an issue that, like in France, is considered from the classic angle of the "brain drain." Concern is being voiced about what will happen to the national scientific community if the brightest graduates leave for the United States. Here again the fears of the 1960s are not far off, but the aspersion is today mainly cast on research facilities which are considered to be far superior in the United States than in Great Britain. According to Britain's prime minister for universities, "unless research facilities are improved, an increasing number of Britain's brightest science graduates will seek research positions in the United States."[6]

The question is still open, driven by the same postulates as twenty or thirty years ago (Gaillard and Gaillard 1998), despite events of the last decade that have contributed to changing the prospects of migration. As the communist system collapsed in Eastern Europe and hordes of Soviet scientists drifted to other professions and countries, and conventional opinion voiced its alarm, new hope was born by those who considered brain drain not as a loss for the country of origin but as a unique opportunity to make up for lost time, to catch up. Some scholars even ventured the idea that outward migration contributed to consolidating an S&T watch network that is vital for a country as enormous as Russia (e.g., Halary 1996).

There are two other phenomena that revived the debate on ISM: first, the large-scale return of the elite to the newly industrialized countries of southeast Asia, especially South Korea (Song 1997), Taiwan, Singapore; and second,

the fact that some countries that suffered brain drain are organizing the S&T diasporas into networks so as to facilitate the circulation of people and information and to initiate collaborative research programs between the national and expatriate scientific communities. The brain drain issue, as it crops up again the world over, bears the print of the traditional approach, which bemoans the losses caused by migration, and a renovated approach which, because of the global trade context, feels this migration may start benefiting the home country.

### *Losers May Also Win*

The dramatic contrast in opinions about the effects of ISM can be traced to its character as a polymorphic, recurrent phenomenon whose costs and benefits have been endlessly, but never successfully, evaluated. Moreover, and as in the past, neglect of certain aspects of the problem has distorted the evaluation. Let us look at the French situation, which is similar to that of many other countries. On one hand, it is most unfortunate that young, well-trained, promising scientists go abroad. But, on the other hand, we need more information on (1) whether their talents would be equally well-used in the home country; (2) the complex benefits that can be derived from such migration through contracts, exchange relations, technological feedback, and so on; and (3) return flows.[7]

Furthermore, in France, migrants are generally computed in the "national losses" list, but to be logical, the balance sheet should also show the advantages obtained from the presence of numerous foreigners who contribute to French national scientific production during the time they study or live in the country. France is second only to the United States in the number of foreign students it receives (United Nations Educational, Scientific, and Cultural Organization [UNESCO] 1997), and yet its reaction to the scientists from the South who stay in the country is ambiguous and seldom enthusiastic,[8] while in the United States, the question may be outstanding but the reaction seems to be more positive.

### *Vulnerable Winners*

The United States, which is the strongest magnet in ISM, especially for foreign students who graduate and then decide to stay there, has been and still is a well-known target for criticism. Voices are speaking out loudly against U.S. theft of the best minds from around the world, and have been since 1965,



when the new U.S. Immigration and Nationality Act Amendment (which actually entered into force in 1968) was introduced. Because this amendment facilitates the immigration of qualified personnel, it encouraged droves of students from the South and professionals from the North to go to the United States. Ever since, the United States has been boasting about receiving the elite of the world. In 1995, an editorial ("The New Immigrants") in *USA Today* stated, "We do not take just 'huddled masses,' we take the best the world has to offer." This state of affairs may not be lasting and comfortable because it makes the American scientific system very vulnerable. Can anyone be sure that the scientific elite in America today will not "pack up and move"? Don't forget that a majority of the scientists in the United States today are of foreign origin. As a way of illustration, up to one-third of engineers and scientists in Silicon Valley are said to be from Taiwan. A number of them have already returned to Taiwan to set up venture businesses in the Hsinchu science park for integrated circuits, computers, and telecommunications which are competing successfully on the world stage (Nathan 1996).

The fact is that the economic paradigm underlying the brain drain (and purporting to show that the country of origin is the loser and the country of destination, the winner) is being reversed in certain countries of the South where the return flow is now effectively under way. South Korea is an interesting example. In the 1970s, close to 70 percent of the Koreans who went to school in the United States stayed there after graduation (only 10 percent returned home immediately after receiving their degree). But the trend has changed. Thus in the 1980s, close to 40 percent of the students went home as soon as they obtained their degree and close to 70 percent went home within three years of receiving their Ph.D. in the United States (Song 1997).

### *When Losers Eventually Win*

What triggered this reversal was regular economic growth during the last thirty years. This situation has reduced the gap in the standard of living between the developed countries and Korea and, coupled with the development of industry and an S&T system, makes it possible for young graduates to work in their home country and in their special discipline without having to accept any major cuts.

South Korea is not the only country where this has happened. A similar situation occurred in Taiwan, where expatriate scientists no longer hesitate to return home. Even in the People's Republic of China, whose students and scientists are the most dubious about returning home, there are indications of a return movement. Improvements in working conditions for scientists, the

national economy, and personal living conditions are making many Chinese engineers and scientists who are living abroad now look at their future from a new angle. Most of these are in the United States, which has received more than 100,000 such immigrants from China. Many of them are keeping their departure on "hold" as they monitor changes at home. Interestingly, according to Zweig and Chen Changgui (1995), the decision to return home is not being based on increased democracy, as might be expected, but rather on the country's scientific open-mindedness, economic growth, and evidence of political stability.

Furthermore, scientists who in previous times feared being isolated within a very small scientific community if they returned to their home country now realize that wherever they may live, they can stay in touch with their peers through electronic communications media. In the global world we now live in, people, information, and ideas travel easily. These new modes of communication and cooperation, paradoxically, may favor both the decision to stay in a foreign country and the decision to go home, because regardless of the choice, they ensure continued contact.

These technological developments are particularly favorable to home countries that try to organize their scientific diasporas to serve the national interest. The idea started with the "brain pool" concept, instituted in 1958 by India through its "Scientists Pool," which was established as an intellectual warehouse for the country to draw on whenever necessary. The idea took hold and grew. During the last decade, many countries have been trying to make an inventory of their scientists abroad, to mobilize and organize them, to reconnect them with the scientific community at home, to capitalize on their work and introduce it to the local scene.[9]

## *Ever Losers*

The aim of the S&T diaspora option is to become a sort of extension of the national scientific community and high-tech labor market. Furthermore, this option enables the expatriated scientists to get to know—and get to be known by—the scientific community in their country of origin, which implicitly repositions them in the labor circuits.

But the S&T diaspora option can only function and facilitate the circulation of the elite if the national scientific communities are sufficiently developed and populous to support the interface. Cooperation and exchanges are impossible if the internal and external scientific community do not have a modicum of shared and overlapping scientific interest. Unfortunately, many



developing countries do not have national coordinating bodies and scientific institutions with the muscle needed to properly manage such a diaspora, nor do they have the minimal socioeconomic or professional conditions needed to open the tap for the return flows. That is why many countries still have to cope with national losses through student/scholar emigration. This applies to a large number of African countries where the scope of the problem has been sizable, even alarming, notwithstanding new policies that are being designed or tested to curtail the effects.[10]

There are other reasons that heighten the losses suffered from these migrations and explain why such losses cannot be offset merely by the return of the scientists or by access to scientific work produced abroad.

In India, for example, where the brain drain has been a steady problem for the last thirty years, the return of a certain number of scientists led to the institutionalization of certain fields of vanguard or cutting-edge research.[11] But, proportionately, there are still too many elite scientists (and not only students) who leave. A good example of this situation may be found in the famous Indian Institutes of Technology (IIT): 30 percent of the students leave India after training at an IIT, and only 3 percent of them return. In sum, the aggregate gains from returning scientists are neutralized by the emigration of scientists and engineers; the country suffers from endemic brain drain (Krishna and Khadria 1997).

Reasons behind the ISM are much the same in many countries: nonexistent or unadapted training curricula (especially in the countries of the South), oversupply of highly qualified staff considering the size of the job market, red tape in universities and scientific institutions, scientific rigidity because of professional hierarchies, insufficient relays between universities and industry, inadequate or no support from banks (risk capital) to underwrite innovations.[12] In response to all this "push" in the home country, there is counterlevering "pull" at the foreign end in the form of scientific dynamism, flexible organization, risk acceptance (both scientific and financial), competitive spirit, and intellectual stimulation. In short, this is what inspired a Chinese scientist in 1971 to say, "Brain goes where brains are, brain goes where money is, brain goes where humanity and justice prevail, brain goes where recognition and healthy competition are assured" (Kao 1971, 37).

## *Dealing a New Hand?*

Even today, it is mainly the institutions in the North and, more specifically, American institutions, which offer conditions considered to be ideal for

practicing science. This circumstance is what still strongly attracts numerous students, scientists, creators of all types, and innovators from around the world, particularly to the United States, and supports the idea that emigration is profitable for the country of destination, an idea expressed by the French and the British as they bitterly observe their elite leave the country to "create wealth elsewhere."

However, while America continues to demonstrate its capacity to draw in "the world's best," its young people at home are showing less and less interest in scientific careers and this trend could turn American science into a highly vulnerable "idol with feet of clay." This cause for concern has resurfaced periodically for the last ten years[13] and has grown to be more serious because of return migration by certain groups of young graduates and mid-career scientists from emerging countries of Southeast Asia.

These return flows are largely encouraged by the growing scientific development in the home countries and the shrinking economic gap between the home and the foreign countries. Furthermore, as exchange relations and collaboration develop through electronic networks and the S&T diaspora grow, expatriate scientists are increasingly being reconnected with their home countries. This has helped change the picture and facilitated return migration. For the time being, the countries of the North are still the major scientific poles and do not feel the brunt of the increase in scientific exchanges which invariably will benefit the emerging countries, whose scientific level is developed enough to exploit them to strengthen their research and development capacity and their S&T potential. For these countries, ISM will amount to complete brain gain.

Other players, however, do not have any cards to play in this game. The national research systems in many countries of the Third World, especially in Africa, hardly produce a significant and visible output on the map of worldwide science. Without grounds for exchange relations between expatriated scientists engaged in cutting-edge research and the virtually nonexistent scientific communities at home, there is little scope for these countries to create a responsive S&T diaspora. In the latter case, since the prevailing conditions favor neither collaboration nor return, the brain drain remains one of the main components of ISM.

## *Notes*

1. The popular science magazine *Sciences et Avenir*, France 2 TV, and France Inter radio station prepared a feature story on "the brain drain," which was simultaneously published in the March 1998 issue of *Science et Avenir* (see pp. 57-68), broadcast by France Inter on 19 February on a program called "Le téléphone sonne," and telecast by France 2 as part of a series called *Envoyé Spécial*.



2. According to a recent report of the Centre National de Recherche Scientifique bureau in Washington, these young French graduates discover the bitter truth that, by getting their post-doc diploma in the United States, they jeopardize their chances to get a job in a French public research organization or a university because students who stay at home are in a better position to "negotiate" the job (Terouanne 1997).

3. "S'expatrier à l'heure de la mondialisation," dossier de Rue des Entrepreneurs, by Didier Adès and Dominique Dambert, Saturday, 7 March 1998 on France Inter.

4. For further information, consult the abundant literature on the brain drain as an issue that peaked in the 1970s and 1980s. The international organizations, rallying to the Third World line of thought, provided an arena and served as a sounding board when nationalist and internationalist thought clashed. Proponents of the former position felt that the migration of the elite from the South was just another example of the North pillaging the South, while proponents of the latter felt, on the contrary, that this migration was normal—in a global market, scientists go where they are best used and paid. The "nationalists" won, and the United Nations defined the brain drain as a one-way migration or an exodus that only referred to a South-to-North migratory trend (i.e., from developing to developed countries), a trend that only benefited industrialized countries with a market economy (Gaillard and Gaillard 1997).

5. The number of foreign students attending Japanese institutions has, however, increased dramatically during the 1980s and early 1990s. More than 90 percent of these students come from other Asian countries, particularly China and the Republic of Korea.

6. Cited in *Nature* (23 January 1998), 62.

7. These questions are not new. They were apparent when the internationalists challenged the nationalists' ideas, but they are as topical as ever.

8. There are several reasons. The first one is related to the political context. The increased influence of the ultraconservative "extrême droite" party rekindled a misguided debate on the problem of migration and security, thereby creating an environment little inclined to capitalize on what foreigners had to offer to higher education and research. The second reason is that more foreign students study literature than the more prestigious scientific disciplines. Another reason is that large numbers of students have been admitted to French universities because of bilateral assistance agreements, which means that their presence is not evidence of the high quality of either the French schools or the foreign students. Thus, in the postgraduate programs, 40 percent of the students are African. The last reason could be connected to the French administration's way of looking at migration. The latter seems to consider this form of mobility as part of the vast problem of the "international migration of job-seekers" and seems to suspect every foreign student of wanting to avoid the normal immigration procedures (Borgogno and Vollenweider-Andresen 1995).

9. Of all these countries, Colombia probably has the most highly developed network of scientists and engineers abroad (Meyer et al. 1997).

10. See the special issue of *Afrique Education*, "Retour en Afrique des cadres et diplômés africains" March 1997, and the special report in *Jeune Afrique Economique*, 1-14 December 1997, "La fuite des cerveaux, le retour des diplômés est-il possible?"(Brain Drain: Is the return of highly skilled Africans possible?) pp. 22-34.

11. Especially in the fields of molecular biology, biotechnology, and computerization.

12. Countries like South Korea that developed broad programs to encourage scientists to return home have worked out answers to each part of the problems.

13. See, for example, *Boon or Bane* (Barber and Morgan 1988).

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