CHANGING TRAFFIC PATTERNS IN TECHNOSPACE

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> *[V]isiting other nations is for Europeans equal to conquering them; treating those countries as if they belonged to no one, and so starting a process of continued oppression of the original inhabitants.*[1]

I. TECHNOSPACE: GLOBALIZING TECHNOLOGY TRANSFER

The term "technospace" is meant to capture the fact that international technology transfer is no longer merely unidirectional or bidirectional, but increasingly omnidirectional and global. Technospace is the planetary locus of economic opportunities for development and application of new technologies. Like cyberspace, market space (or, for that matter, petrospace or outer space), technospace can, and because it can, should be explored, occupied, or even conquered.[2]

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1. IMANUEL KANT, ZUM EWIGEN FRIEDEN (1795), *quoted in* Bob Goudzwaard & Julio de Santa Ana, *Globalization and Modernity*, *in* GLOBALIZATION: THE IMPERIAL THRUST OF MODERNITY 7 (Ninan Koshy ed., 2002) [hereinafter GLOBALIZATION].

2. "The new open empty space to be conquered is none other than the global market." GLOBALIZATION, *supra* note 1, at 18. "Market space" is common parlance in the telecoms industry. *See, e.g.*, Gerry Faulhaber, *The Broadband Market Space*, *at* http://rider.wharton.upenn.edu/~faulhabe/broadbandspace.pdf (last visited Sept. 30, 2004). The

In a recent article, "Globalization and Modernity," Bob Goudzwaard and Julio de Santa Ana develop a theory of globalization: the gradual "emergence" of market opportunities in developing countries for transnational corporations resembles the occupation of "empty space" or *terra nullius*, as though the traditional patterns of production and distribution of social goods in those societies were invisible, paltry, and meaningless.[3] The engine driving this one-way traffic is the ideology of "progress":

> The great industrial leader Carnegie[*'s*] . . . *Gospel of Wealth* [is] a book which . . . ends with the line that peace will return fully on earth if we follow the path of progress "obediently." The ideological transfer along with the dynamism of the faith in progress, also brings about after 1850 a more or less permanent change in the interpretation of modernity itself. From that time modernity begins to function primarily as a continuous dynamic "programme" that may be called "modernisation" [sic]. For there grows a general belief that humanity can and will go forward in all aspects of life, so long as it sustains the full impact of the "forces of progress" (technology, economy and science) and continues in the context of the new institutional mechanisms of modernity, [such as] those of the free market and of democracy.[4]

Goudzwaard and de Santa Ana observe, however, that while the centrifugal thrust of modernization from center to periphery, from the industrial economies of the latter half of the 19th century to the human species in every

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term "cyberspace" was apparently invented by William Gibson, best known for using it in his 1984 novel *Neuromancer*. It appeared two years earlier in a short story by Gibson in *Omni Magazine*. *See* William Gibson, *Burning Chrome*, OMNI, July 1982, at 72. Dan Schiller has conflated the two concepts: "Cyberspace itself is being rapidly colonized by the familiar workings of the market system." DAN SCHILLER, DIGITAL CAPITALISM, NETWORKING THE GLOBAL MARKET SYSTEM xiv (1999), *quoted in* GLOBALIZATION, *supra* note 1, at 19. The "Enterprise" analogy to exploration of outer space goes without saying. A former astronaut recently recapitulated the "Trekkie" mantra:

> Returning to the moon to stay, as Bush has proposed, would mark a change in human history comparable to our species' movement out of Africa about 150,000 years ago. If Americans are once again leading this effort, that return to stay also would mark a political milestone comparable to the first permanent settlement of free men and women in the New World.

Harrison H. Schmitt, *Let Us Boldly Go Where Man Went Once Before*, CONCORD MONITOR, Jan. 19, 2004, at B5. For a perhaps already passé reference to seabed exploration by "The Enterprise," see Part VI of the United Nations Convention on the Law of the Sea, Dec. 10, 1982, 21 I.L.M. 1261. For technology opportunities in "petrospace," see the discussion of Evans, *infra* note 11 and accompanying text.

3. For a review of anthropological speculation on the lifestyle and consumption levels of the traditional peoples of North America in 1491, before the arrival of European settlers (or, as astronaut Schmitt calls them, "free men and women"), see Charles C. Mann, *1491*, THE ATLANTIC MONTHLY, Mar. 2002, at 41.

4. GLOBALIZATION, *supra* note 1, at 10.

corner of the planet in the first half of the 21st, has been driven by the new normativity of modernization, it has not been accomplished without payment of a spiritual price by its proselytizers.

> Modernity is about freedom, equality, the organization of well-being and emancipation, but when these elements do not naturally fit together, the modern era cannot *a priori* exclude a practice of oppression or inequality. The deep dialectical tensions within [the] Enlightenment were highlighted by Adorno and Horkheimer in the 20th century. But the ambiguity was already perceived earlier by Goethe ("There are two souls combating in my heart." *Faust*) leading to the striking comment by Paul Ricoeur that "while we progress at the level of having, we become lost and disoriented at the level of being. In the course of time, this ambivalence in modernity led to an intensive search for escape routes. The hope for and trust in the 'making of a better future' especially began that way – a future in which all those nasty tensions could be resolved once and for all, on the basis of continuous technological, economic, and intellectual achievements by human beings. That perspective began, so to say, to secure the roof of the building by holding the walls together.[5]

Progress–for its promoters, a quest or a spiritual flight from self? According to these authors, Progress is the modern spiritual "escape hatch" from the "level of having" to the "level of being," leading its proponents to find meaning (and a bit more "having" in the process) not just by enjoying directly, but by bringing to lands in which, and peoples to whom, it never occurred, the freedom of choice, equality of opportunity, and economic development the "West" enjoys. The proponents of modernization desire to imagine that the peoples of these places are wanting of the blessings of freedom, equality, and development (although they may not know it yet and have not been asked), so as to justify bringing, selling, or contracting out for the supply of such blessings to them. Meanwhile back home, spirituality itself is up for sale.[6]

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5. *Id.* at 8.

6. *See* Pam Danziger, *Market for Self-Actualization: The Ultimate Luxury*, *at* http://www.refresher.com/!pdluxury.html, noting

> The natural evolution of all luxury concepts is from class to mass. In other words, luxury is first adopted by the affluent and wealthy, then inevitably it is translated and reinterpreted down to the mass market. So today's luxuries become tomorrow's necessities. As luxury marketers, we have to stay out in front of the luxury consumers, discovering new and different ways to give expression to the luxury consumers' desires. New technology creates new luxury needs and business opportunities, such as plasma televisions, enhanced PDA's and digital photography equipment. Changes in fashion, too, are a way to continually reinvent luxury, so today colored diamonds are hot. But to assure the greatest long term success luxury marketers need to connect with the luxury consumers' inner emotional lives and create new products and services to meet those needs. For today's luxury consumer with an excess of things, achieving self-actualization, as defined by Abraham Maslow's hierarchy of needs, is the ultimate expression of their most compelling luxury desires.

And what is modernization for its recipients, its "beneficiaries" in the East and the South? They must sacrifice today in order to achieve that better tomorrow.[7] A full critique of globalization and the responses thereto are beyond the scope of this paper.[8] Goudzwaard and de Santa Ana focus on the extent to which the narrow needs of the global capital markets, rather than the broad needs of as yet unmodernized societies, drive the process. We can start there.

What are the alternatives? Opposition to modernization rarely comes from the poor themselves or development officials; more often it emanates from vociferous Non-Governmental Organizations as well as tacitly from traditional elites who have much to lose from global competition and everything to gain from maintenance of a comfortable *status quo*. Policy-makers in developing countries with appropriate market size and levels of education reject the anti-modernization movement and embrace modernization, while remaining wary of economic combinations.[9] Export

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7. *See, e.g.*, Third World Traveler, *Structural Adjustment: How the IMF/World Bank Exploits the Globe*, *available at* http://www.thirdworldtraveler.com/Global_Economy/Structural_Adjustment.html (last visited Sept. 30, 2004). "[S]ometimes the dynamic, long-term benefits of IPRs could conflict with other short-term public policy objectives." JAYASHREE WATAL, INTELLECTUAL PROPERTY RIGHTS IN THE WTO AND DEVELOPING COUNTRIES 2 (2001). *See generally*, JOSEPH E. STIGLITZ, GLOBALIZATION AND ITS DISCONTENTS (2002).

8. The Davos/Porto Alegre "food fight" may obscure an even deeper and more ominous concern. Professor Jared Diamond notes a prior case of conspicuously competitive human consumption in a tropical paradise:

> The Easter Islanders' isolation probably explains why their collapse, more, perhaps, than the collapse of any other pre-industrial society, haunts readers and visitors today. The parallels between Easter Island and the modern world are chillingly obvious. Thanks to globalization, international trade, jet planes, and the Internet, all countries on Earth share resources and affect each other, just as did Easter's eleven clans. Polynesian Easter Island was as isolated in the Pacific Ocean as the Earth is in space. When the Easter Islanders got into difficulties, there was nowhere to which they could flee, or to which they could turn for help; nor shall we modern Earthlings have recourse elsewhere if our troubles increase. Those are the reasons why people see the collapse of Easter Island society as a metaphor, a worst-case scenario, for what may lie ahead in our own future.

Jared Diamond, *Twilight at Easter*, NEW YORK REV. OF BOOKS, Mar. 25, 2004, at 6, 10.

9. The clearest example is China's "non-ideological" adoption of the "Four Modernizations" (agriculture, industry, S&T, military) at the Third Plenum of the Eleventh Chinese Communist Party Central Committee in September 1978. China's subsequent phenomenal growth has not gone unnoticed in countries like India and Brazil. With growth comes clout. *See* Kathryn Kranhold, *China's Price for Market Entry: Give Us Your Technology Too*, ASIAN WALL ST. J., Feb. 26, 2004, at A1.

strategies replace import substitution. They send the "best and brightest" for training in the United States and Europe.

At some point perhaps, technology spilling over from developed countries is not merely absorbed into the local terrain; if the soil in that local terrain has been properly prepared by sophisticated Western-trained local elites, that technology may begin to sprout new branches. What I hope to accomplish in this paper is merely to comment on "modern" international technology transfer as it is traditionally perceived to transpire from the center to periphery – that being a perpetual "one way" street heading from North to South – and then speculate on some indications that may harbinger changes in that traffic pattern toward a truly global technospace.[10] Whether that is a good or bad development from the perspective of "international public policy" (if such a thing exists), given the concerns of writers such as Goudzwaard and de Santa Ana as set out above, is an entirely different and a more difficult question.

II. SO MUCH FOR RHETORIC: DO DEVELOPING NATIONS REALLY NEED OR WANT ACRYLONITRILE?

As Dustin Hoffman's Benjamin in *The Graduate* in the late 1960's discovered about the future, "I've got one word for you . . . 'plastics.'" Since that era, Larry Evans has been one of the leading figures in the Licensing Executives Society, a worldwide organization of licensing (technology transfer) professionals with chapters in 30 countries, including Argentina, Brazil, China, India, Mexico, and the Philippines (as well as a student chapter at Franklin Pierce). Evans recently summarized 35 years in the licensing business at Sohio/BP, where he was in charge of intellectual property.[11] Before it was broken up in 1911, Standard Oil controlled about 80 percent of the petroleum refining, transportation and marketing capacity in the United States. In the 1950's, Sohio chemists and researchers developed a process for upgrading the by-products of ethylene production or catalytic cracking into acrylonitrile, an important intermediate in the production of synthetic wool and acrylonitrile butadiaene styrene (ABS) engineering grade plastics.

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10. "Traditional" international tech transfer is sometimes called the "benchmark model." "There are two regions in the model: the North which houses all innovative firms; and the South, which houses all imitating firms." Michael W. Nicholson, *Intellectual Property Rights, Internalization and Technology Transfer*, 6 (FTC Working Paper No. 250, 2002), *at* http://www.ftc.gov/be/workpapers/ wp250.pdf (last visited Sept. 30, 2004) (FTC Bureau of Economic Working Papers).

11. Larry W. Evans, *Challenges and Opportunities in Licensing to Emerging Economies*, 38 LES NOUVELLES 163 (2003).

According to Evans, 98 percent of world production of 10 billion pounds of acrylonitrile in 1993 was still manufactured by means of the Sohio Acrylonitrile Process.[12] The company developed a licensing program for the process. Patents were secured but the core technology remained trade secrets (primarily catalysts) and know-how. It took that licensing program to China, Taiwan, Mexico, Romania, Bulgaria, East Germany, the USSR, and Korea. Among the "challenges" Sohio faced in its licensing program in such countries, Evans identifies: (1) overprotective laws and regulations (compulsory registration of licenses, limitations on confidentiality and royalty payments, export restrictions, and requirements relative to use of local technology); (2) failure to recognize that trade secrets and know-how are proprietary; and (3) utilization of disinterested intermediaries (i.e., government bureaucrats) to negotiate the licenses.[13] The writer sums up his experiences with a poignant illustration:

> A particularly regressive set of regulations are those which require that the licensee utilize local technology, equipment, components, etc. . . . This may be an acceptable regulation in theory; however, it is often very regressive in practice. The infamous incident in Bhopal, India Union Carbide plant some 20 years ago was caused, I believe, by this requirement. Necessary safety equipment at the plant had failed and had to be replaced. It would have been relatively easy and have required very little time to replace the equipment with equipment from outside India. This could not be done, however, unless and until it could be certified that the needed equipment was not available in India. The delay caused by the certification proved to be fatal to several hundred people.[14]

For local stakeholders (particularly development officials and the educated elites) in mid-level "emerging" and large market developing nations, there simply was no way around the need to import Sohio's technology on preferential terms. Sohio even got to build the plants:

> [A]dditional leverage was Sohio's catalyst which was necessary for continued operation of the licensed plant, Sohio's multilateral improvement exchange with most of its licensees and Sohio's close working relationship with only two or three international engineering contractors who were qualified to design, engineer and construct the licensed plants.[15]

From the licensor's standpoint, the inevitability of the decision to transfer the technology, notwithstanding the risks, went without saying:

> Why would any owner of a valuable technology put that technology at risk by licensing it to an emerging economy if all of these problems exist? The answer is

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12. *Id.*
13. *Id.* ("It's like negotiating for a Yugo when a Mercedes is wanted.").
14. *Id.* at 164.
15. *Id.*

> simple–the emerging economies offer the most potential for business growth in the world. For example, when I became involved in licensing technology to China, it was a country with more than a billion two hundred million friendly, educable and potentially industrious people. Its economy had been growing at a double-digit rate for more than ten straight years. It was worth the risk.[16]

How tough were the Sohio negotiations? In Evans' first meeting with the potential Chinese licensee, "there were some 30 representatives on the other side of the table, each of whom knew a lot about one or more areas of the technology."[17] "Many developing countries, notably Brazil and China, continue to follow the ideological approach, that is, to impose restrictions on know-how trade secret and know how licensing, refusing to recognize property rights in unpatented technology and limiting terms of confidentiality and royalties related to such transfers."[18] Evans cites an unnamed Argentinian "policy-maker" criticizing such local intransigence:

> [T]he approach to [technology transfer and foreign investment] . . . must be economic and not ideological. When this last happens (i.e., the ideological approach), and it has happened, technology and investments shall be farther and farther from our countries.[19]

We can perhaps interpret the necessary implication of the "policy-maker's" statement that the economic approach is "non-ideological" to mean that the demand for plastics in those countries overrode import substitution policy. According to Evans, in Mexico, India, and China, among other places, government officials were able to bend the rules in Sohio's favor, interpreting the 5 or 10-year limit on secrecy to toll from the date of the last disclosure of confidential information.[20] "Such a clause is only effective if the licensee agrees to an improvement exchange and if the licensor continues its R&D relating to the licensed technology."[21] To "policy-makers" in the countries Evans mentioned, representing members of the local political and manufacturing elites, the need to import acrylonitrile technology justified bending the rules. It was a "win-win" situation for them, as it was for Sohio. Globalization of acrylonitrile technology is a Sohio success story. Sohio works for Brazil, India, Argentina, and mainland China and Taiwan; and Brazil, India, Argentina, mainland China and Taiwan work for Sohio.[22]

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16. *Id.*
17. Evans, *supra* note 11, at 164.
18. *Id.* at 165.
19. *Id.*
20. *Id.*
21. *Id.* at 165-166.
22. For background on Taiwan's national plastics strategy, see, e.g., Laurids S. Lauridsen, *Policies and Institutions of Industrial Deepening and Upgrading in Taiwan I – The*

> Emerging economies such as those in China, India, South American and Eastern European countries offer outstanding opportunities for licensors, equipment suppliers and engineering contractors. These countries have large populations, geographical advantages and necessary raw materials; they also present new opportunities for licensing technology which has already been licensed in the OECD (Organization for Economic Co-operation and Development) countries.[23]

Large developing countries moving from import substitution to export promotion needed plastics for all sorts of products. And because of Sohio's proprietary position in catalysts and other know-how–not patents–"inventing around" the process was not a possibility.

The blandishments of economic development and the momentum of global participation are drawing closer to the developed country "IP attitude" the kinds of countries Sohio found attractive for its licensing campaign.[24] The smallest country in Evans' survey is Romania, a mid-income country with a population of 22 million. But does this kind of international technology transfer work for Bangla Desh, Rwanda, Bolivia, or Jamaica? Evans does not mention them. Can developing or least-developed countries, landlocked or small island, or those burdened with large populations but without "geographical advantages," educational infrastructure, or raw materials, cursed more by "latitude" than "attitude,"[25] participate in globalization's benefits without the staunch support of their larger developing country neighbors? Peter Drahos notes skeptically:

> Some developing countries are arguably worse off than in the past. During the Cold War, least-developed countries (LDCs) had the benefit of India and Brazil's leadership of a broad coalition of developing countries, a coalition that mainly expressed itself in the form of the Group of 77 (G77). The G77 has faded in importance. It is also not clear that India and Brazil are prepared to provide the general leadership on intellectual property issues that they once did. In part, this is because some Indians believe that India has something to gain from parts of the intellectual property regime, such as copyright and geographical indications. China

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Basic Industry Strategy in Petrochemicals, Vol. 4. (Working Paper No. 15) [hereinafter Working Paper No. 15], *at* http://www.globasia.dk (last visited Sept. 30, 2004); Laurids S. Lauridsen, *The International Petrochemical-Plastic Complex–Structures and Actors*, Vol. 2. (Working Paper No. 11) [hereinafter Working Paper No. 11], *at* http://www.globasia.dk (last visited Sept. 30, 2004).

23. Evans, *supra* note 11, at 166.

24. "By Punta del Este [in 1986] the twenty-five 'hardliner' developing countries of mid-1985 had by now shrunk to only ten." WATAL, *supra* note 7, at 19 (AR, BR, CU, EG, IN, NI, NG, PE, TZ, YU). Three of those ten are in Evan's report. *See* Evans, *supra* note 11.

25. Ricardo Hausmann, *Prisoners of Geography*, FOREIGN POLICY, Jan./Feb. 2001, at 44.

> remains an unknown quantity as a leader. Processes of modernization (and modernity) are fragmenting what was once a more unified bloc of countries.[26]

In 2004, the evidence that such leadership is lacking is much clearer than it was for Professor Drahos just a few short years ago.[27] The "unknown quantities" are out in the open. There is a growing dearth of solidarity in the South as aggressive modernization co-opts its largest, strongest, and most richly infrastructured states.

III. "SPILLOVER" ABSORPTION IN THE TECHNOSPACE PERIPHERY

The foregoing may be because the major technology followers such as India, China, and Brazil have now reached a stage in their economic development where they want to be, and can be technology leaders. The past benefits of the "follower" position are clear for the pharmaceutical industry in India. Nagesh Kumar, in a paper originally written for the vaunted British "Commission of Intellectual Property Rights" study, makes the case for India's efforts to build technological capability to provide affordable medicines by switching from a stronger to a weaker IP regime.

> [T]he ongoing attempt to harmonise and strengthen the IPP regimes worldwide, as a part of the TRIPS Agreement, appears to be adversely affecting the technological activity in developing countries by choking the knowledge spillovers from industrialized countries to developing countries . . . . The global technology generation or innovation activity is known to be highly concentrated in a handful of developed countries. An extreme form of concentration is apparent from some indicators of technological inputs (e.g., R&D expenditure) and outputs (e.g., earnings of U.S. technology licensing fees and FDI outflows) . . . with just 10 countries accounting for the bulk of all technological activity in the world. The top 10 countries account for as much as 84 percent of global resources spent on R&D activity annually, they control 94 percent of technological output in terms of patents taken out in the US, and receive 91 percent of global cross-border royalties and

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26. Peter Drahos, *Developing Countries and International Intellectual Property Standard-Setting*, 5 J. WORLD INTELL. PROP. 765 (2002). But new coalitions in the WTO Doha Round since China's entry are intriguing.

27. On the Brazil/China/India axis, "[a]ccording to the documents, which also provide managers with detailed advice on how to talk about the moves and their effect, IBM plans to shift the jobs from various U.S. locations to China, India and Brazil, where wages for skilled programmers are substantially lower." William M. Bulkeley, *IBM Documents Give Rare Look At Sensitive Plans on "Offshoring"*, WALL ST. J., Jan. 19, 2004, at A1. See also the proposed Jumpstart Our Business Strength (JOBS) Act amendments of 2004, S. 1637, 108th Cong. (2004), which would prevent U.S. companies that win federal government contracts from moving the work offshore if that work was previously done in the U.S. Edward Alden, *Election Debate on Job Exports Spills Into Corporate Arena*, FIN. TIMES (London), Mar. 5, 2004, at 2.

> technology license fees. . . . This extreme concentration of the technology generation activity with 94 percent of patents and 91 percent of technology fees receipts accounted for by just 10 developed countries has implications for the strengthening of IPR regime[s]. It is quite clear that a trend of strengthening of the IPR regime will benefit these countries and will further perpetuate their technological domination over the rest of the world.[28]

Pointing to Cohen and Levinthal's 1989 "two faces of R&D" study, Kumar notes "the positive absorption incentive associated with spillovers seemed to increase relative to the negative appropriability incentive in the case of many industries."[29] India's Patents Act of 1970

> reduced the scope of patentability in food, chemicals and pharmaceuticals to only processes and not products. Since virtually any chemical compound can be made by a variety of processes, the scope of patent protection was greatly reduced. The term of process patents was reduced to seven years in food, drugs and chemicals and to 14 years for other products. Compulsory licences could be issued after three years.[30]

At the time of the 1970 Act, the vast majority of India's drug industry was dominated by multinational corporations. This was unlike Sohio's acrylonitrile process, so dependent on trade secrets; where product patent protection is absent and there are many methods of making the product, process "spillover" brings technological capacity.

> A number of studies have empirically demonstrated the ability of rather weaker intellectual property rights in stimulating domestic innovative activity in developing countries to absorb spillovers of foreign R&D. [One such study] of Indian enterprises found evidence of their R&D activity absorbing considerable foreign R&D spillovers facilitated by the weak Indian patent regime. [Another] found Indian chemical industry enterprises to be among the more innovative ones in the Indian industry. They attributed this to the weak patent laws, *viz.*, absence of product patents in India which enabled Indian enterprises to undertake alternative process development.[31]

Addressing the impending application of the TRIPS Agreement to pharmaceutical industries in countries such as India beginning in January, 2005, Kumar's recommendations included incorporating into India's laws provisions for compulsory licensing, research exceptions, early working ('Bolar') exceptions, resistance to TRIPS-plus pressures from the E.U. and U.S., liberalizing parallel imports, breeders and farmers' exceptions in plant variety exceptions, price controls for essential drugs, a moratorium on

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28. Nagesh Kumar, *Intellectual Property Rights, Technology and Economic Development–Experiences of Asian Countries*, 38 ECON. & POL. WKLY 209-10 (2003).

29. *Id.* at 211 (citing W.M. Cohen & D.A. Levinthal, *Innovation and Learning: The Two Faces of R&D*, 99 THE ECON. J. 79 (1989)).

30. *Id.* at 218.

31. *Id.* at 211.

strengthening TRIPS, and development of codes for technology transfer for developing countries on favorable terms from patent owners.[32] The follower position is evidently alive and kicking.

IV. GLOBALIZATION OF R&D: THE "THIRD WORLD" STRIKES BACK

Others in India have emphasized that the follower position has its attendant drawbacks. The very Indian companies Kumar mentions are building their own patent portfolios. As one Indian drug company executive recently put it,

> A better way to maximize returns in the long run would be to allow the developing nations to mature to a level where they acquire a threshold level of R&D capability and in the process strengthen their economies. At that stage, a nation will be driven by an internal need to adopt stronger IP laws. For example, the Indian pharmaceutical industry has built capabilities in process research from 1970 onwards. It is now prepared to undertake drug discovery research.[33]

The eponymous Dr. Anji Reddy himself, while proclaiming the success of India's weakening of its patent laws in 1970 in allowing India to build its process technology base, recently acknowledged that by the early 1990's the time for change had arrived.

> Less than six months after man landed on the moon, the pharmaceutical industry in India was granted a great boon–the patent laws were changed and the Indian Patent Act of 1970 was passed. Product Patents for medicinal products were no longer recognized and only process patents continued to be recognized. [The] pharmaceutical industry in India grasped this opportunity with both hands and proved dramatically that its reverse engineering skills were second to none in the world. Also this has resulted in the birth of affordable medicine.
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> While everyone [was] pre-occupied feasting [on] this opportunity, in 1992, I started thinking in an entirely different way–"with 25 years of experience of synthesizing a plethora of drugs that involve 2 to 20 steps," can we get into drug discovery and make a difference?
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> I made up my mind that we can and took the plunge on 6th November 1993. We jumped into [d]iscovery with a budget of about Rs.6.5 crores [($1.4 million)]. In the current financial year we have budgeted an expenditure of Rs.165 crores ($36 million), a 25-fold increase in the R&D spend[ing].[34]

Writing in 1995, Dr. Ramesh Mashelkar, Director General of the Indian Council of Scientific and Industrial Research, took up Dr. Reddy's call:

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32. *Id*. at 222-24.

33. Private conversation with author (Jan. 23, 2004).

34. Dr. K. Anji Reddy, Address at the Dr. Reddy's Research Foundation Pharmacophore 2004 (Jan. 17, 2004), *at* http://www.indiainfoline.com/nevi/rere.html (last visited Sept. 30, 2004).

> As we know, opening up of the economy and integration of the Indian economy with the global process that has already gained momentum over the last five years. There is a mistaken notion that opening up will result in our having unlimited inflow of technology and therefore we do not have to now worry about developing strength by sweating it out! After all, technologies will be available on [a] platter. All that we have to do is to acquire them and adapt them. Nothing can be further from the truth.[35]

Large developing countries such as India, China, and Brazil with large populations of potential consumers, rich natural resources, and an educated class can always attract investment even without strong IPRs. But what is missing from the follower position is the incentive of the technology producer to deal in its *best* products. And without the best technology products, so go the best technology markets:

> Why not form joint ventures and, then of course, technology will be available to us from our foreign partners? This is not quite right again. It needs to be emphasized that equality in equity based joint ventures will have to be earned and not demanded. This equality can be earned only when we have strong technological muscle ourselves. When our Indian pharmaceutical company Ranbaxy wanted the famous Eli Lilly from USA to be partners, they were not very successful in persuading them, since Eli Lilly was lukewarm. However, the moment Ranbaxy demonstrated their technological prowess by developing Cefaclor, a leading antibiotic, and capturing a share of the world market, Eli Lilly developed a sense of respect for them and became partners with Ranbaxy. We must recognize that eventually strength begets strength.[36]

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35. R. A. Mashelkar, Making Economic Sense of Science: The Emerging Indian Challenge, Lecture at the Inter University Centre for Astronomy and Astrophysics, Pune (Dec. 29, 1995).

36. *Id.*; *see also* Kumar, *supra* note 28, at 220, noting

> The technological capabilities of Indian companies have grown to a point when leading MNEs have started to take note of it. For instance, Eli Lilly established a joint venture with Ranbaxy in the mid-1990s for development of a cost-effective process for synthesis of Cefaclor, among other products, taking advantage of the latter's process development capabilities. Similarly, Bayer contracted Ranbaxy to develop single dose formulations of its proprietary Ciprofloxacine. A number of leading MNEs have also contracted Indian public funded R and D institutions for synthesis of new molecules and process development. These include Abbott Laboratories, Parke Davis, and Smith Kline and Beecham [now GlaxoSmithKline], among others, that have commissioned Indian Insitute for Chemical Technologies, Hyderabad and National Chemical Laboratories, Pune. Astra (now Astra-Zeneca) has set up a full-fledged R and D centre in Bangalore to draw upon trained manpower and research infrastructure available in the country, despite the fact that [the] Indian patent regime does not provide product patents.

More recent news of Ranbaxy's "reverse transfer of technology" and a description of its research park at Haryana, near New Delhi, can be found on its website at http://www.ranbaxy.com/rnd_achievements.htm (last visited Oct. 20, 2004).

The United States "is the biggest market for India's pharmaceutical exports, accounting for 10-12 percent."[37]

Four years later in 1999, Mashelkar honed in on the changing traffic pattern from a different perspective–the delocalization of R&D from the standpoint of MNC corporate strategy.

> One would do well to take note of the geographic dispersal of R&D activities by multinational corporations (MNCs). It is important to understand the causes, nature and implications of this trend because technological change is central to economic growth. Also it is necessary to comprehend the corresponding structural changes that would be necessary to capitalize on the emerging opportunities. A fundamental change seems to be taking place in the nature of the MNCs. They are no more tied down to a home country in terms of a base for organisation, capital and R&D. Increasingly, they are ceasing to be the controlling and coordinating centers for a set of peripheral and independent national subsidiaries and acquiring the character of a network where national units are viewed as sources of ideas, skills, capability and knowledge to be harnessed for the total good of the company. International exploitation of national technological capabilities by major firms is on the rise.[38]

In 1999, inventors from only a handful of developing countries were granted more than 40 patents in the USPTO. These were Argentina, Brazil, China, Hong Kong, India, Mexico, South Africa, Singapore, South Korea, and Taiwan.[39] But, a change seems to be underway.[40] Take Patent Cooperation Treaty international filings as an illustration. Among the countries from which over 100 international applications were filed in 2002, there was a significant increase in PCT applications filed by applicants from India (51.9%), Mexico (19.6%), Singapore (18.8%) and the Republic of Korea (10.1%). A total of 5,359 international applications originated from developing countries (out of a total of 114,048), the highest number originating from the Republic of Korea (2,552, 8th place), China (1,124, 15th place), India (480, 22nd place), South Africa (407, 23rd place), Singapore (322, 24th place) and Brazil (204, 27th place).[41]

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37. Kumar, *supra* note 28, at 219.

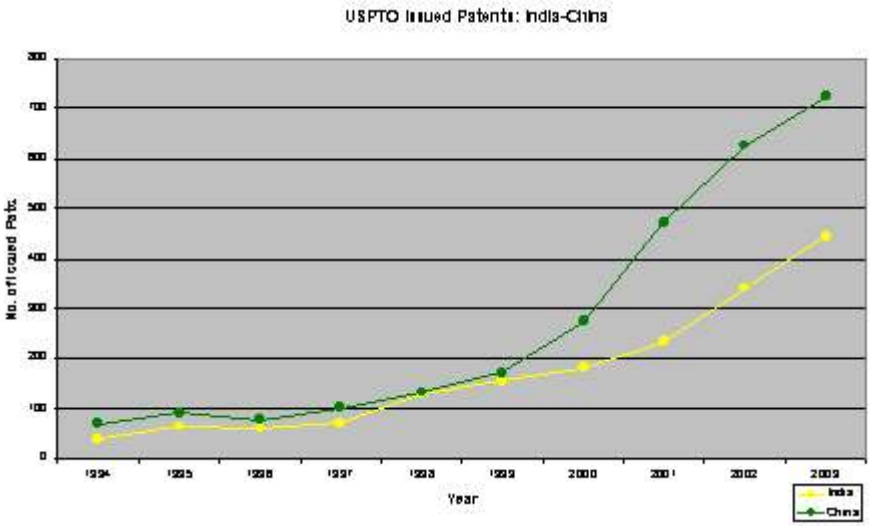
38. R.A. Mashelkar, Science, Technology, Innovation: Their Impact on Economic and Political Power, Lecture at the India International Centre, Bose Einstein Lecture (Dec. 13, 1999), *at* http://www.nifindia.org/Bose-Einstein.htm.

39. WATAL, *supra* note 7, at 95.

40. Given recent interpretations of the scope of patent infringement in the United States, MNCs may be increasingly likely to become the willing partners of R&D institutes in developing countries. *See* Bayer AG v. Housey Pharm., Inc., 340 F.3d 1367 (Fed. Cir. 2003) (holding that the use outside the U.S. of a patented method for screening cells to identify new compositions for testing inside the U.S. is not an infringement of 35 U.S.C. § 271(g) because it is not "made" by the process).

41. *See* Yearly Review of the Patent Cooperation Treaty: 2002, *at* http://www.wipo.int/pct/en/index.html (last visited Oct. 20, 2004). Whether OECD member

The increase in the number of U.S. patent filings and patents issued from those countries is also astounding. The following graph indicates patents by "country of inventor" for India and China issued by the USPTO over the past decade.[42]



Looking at particular classes can also be enlightening. For example, U.S. Class 424 generally covers drug and bio-affecting compositions, body-treating compositions, and fermentates (e.g., antibiotics), plant and animal extracts, body fluids, or animal and plant cellular structures.[43] The following graph shows the change in issued U.S. patents from inventors in selected Asian countries over the past five years.[44]

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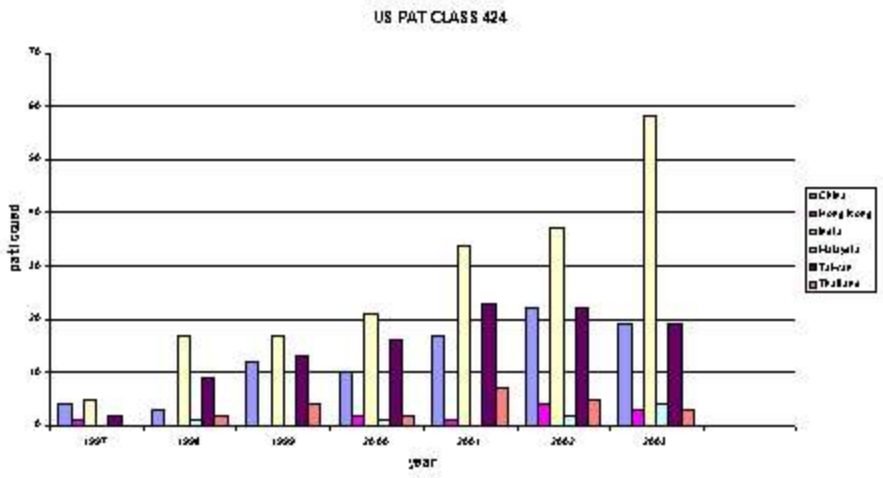
states such as Singapore, South Korea, and Mexico should be considered "developing countries" is debatable.

42. Courtesy of Questel-Orbit, Inc. (patent information databases) [hereinafter Questel-Orbit].

43. United States Patent and Trademark Office, Drug, Bio-affecting, and Body Treating Compositions, *available at* http://www.uspto.gov/go/ classification/uspc424/defs424.htm (last visited Oct. 20, 2004).

44. Questel-Orbit, *supra* note 42.



Of the 57 U.S. patents issued in 2003 in Class 424 to inventors identifying themselves as nationals from India, 26 (46%) are assigned to Mashelkar's Council on Scientific and Industrial Research (CSIR). They include anti-bacterial treatments,[45] immuno-deficiency treatments,[46] herbal cancer-inhibitors,[47] gene based method for screening anti-tuberculosis drugs,[48] a mangrove-plant derived molecule for mediating gastric secretions,[49] herbal essence-based insecticides,[50] etc., perhaps reflecting both the broad range of Indian flora and the pervasive use of plants in the treatment of disease and as insecticides and fungicides in Indian society.

The dietary supplements category established by the FDA pursuant to the Dietary Supplement Health and Education Act of 1994 appears to have created a market for dietary supplements which are neither food additives nor drugs.[51]

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45. U.S. Patent No. 6,667,062 (issued Dec. 23, 2003).
46. U.S. Patent No. 6,664,236 (issued Dec. 16, 2003).
47. U.S. Patent No. 6,649,650 (issued Nov. 18, 2003).
48. U.S. Patent No. 6,645,505 (issued Nov. 11, 2003).
49. U.S. Patent No. 6,638,546 (issued Oct. 28, 2003).
50. U.S. Patent No. 6,623,766 (issued Sept. 23, 2003).
51. *See* 21 U.S.C. § 321(1994).

This law created a new category called Dietary Supplements which includes herbs. The act declares these substances are not food additives nor are they drugs. It allows manufactures to publish more complete directions for use than previously allowed including warnings, contraindications, and side effects. The act also allows manufacturers to publish limited information regarding the benefits in the form of Statements of Nutritional Support as well as Structure and Function Claims.

William B. Stavinoha & Neera Satsangi, Status of Ganoderma Lucidum in United States: Ganoderma Lucidum as an Anti-inflammatory Agent, Lecture at the Ganoderma Lucidum Symposium (Nov. 17-18, 1997), *at* http://www.kyotan.com/lectures/lectures/ Lecture4.html.

U.S. patents issued to Chinese inventors in Class 424 include dietary supplements, anti-immunological deficiency treatments,[52] anti-infertility treatments (modafinil),[53] and plant-based pesticides.[54]

Many of these plant-based medicinal treatments, insecticides and fungicides appear have the character of what has been called "new traditional knowledge."[55] Liu defines "new traditional knowledge" as

> new knowledge created by new generations who base or partially base their creations on traditional knowledge. Basically, new traditional knowledge has the following characteristics: (1) it may involve a process or a product; (2) it can be expressed in one of the most used languages worldwide or in one indigenous, local or tribal language; and (3) it has been and will remain part of traditional knowledge, on which other new traditional knowledge could be created.[56]

Liu describes the patenting of "new" traditional Chinese medicine (TCM) in China, where the novelty lies in (1) new techniques for preparing TCM, (2) isolation of active components in TCM products, (3) new applications for TCM (e.g., anti-HIV/AIDS, anti-cancer), (4) new combinations of TCMs and Western medicines (combination immune-antibiotics) and (5) new pathways for administering TCMs.[57]

The countries of Africa and South America have not been so aggressive in exploring technospace. The graph below illustrates that the comparable statistics for U.S. issued patents identifying inventors in the two largest South American countries, Brazil and Argentina, are much lower than for India.[58]

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52. U.S. Patent No. 6,468,542 (issued Oct. 22, 2002).

53. U.S. Patent No. 6,465,519 (issued Oct. 15, 2002).

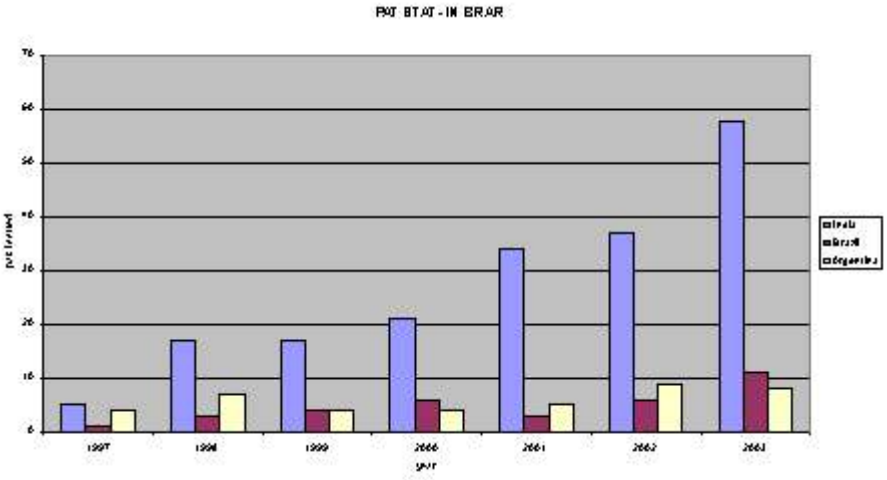
54. U.S. Patent No. 6,372,239 (issued Apr. 16, 2002).

55. *See* Yinliang Liu, *IPR Protection for New Traditional Knowledge: With a Case Study of Traditional Chinese Medicine*, 25 EUR. INTELL. PROP. REV. 194 (2003).

56. *Id.*

57. *Id.* at 198-99.

58. Excluding South Africa, total issued patents in the U.S. from African inventors in the period 1997-2002 are Cameroon (1), Madagascar (2) Zimbabwe (1), Liberia (1), Niger (1), Nigeria (5), Egypt (7), and Morocco (1). Questel-Orbit, *supra* note 42. The continuing "follower" attitude of Argentina and Brazil is evidenced in Part V of the World Intellectual Property Organization, *Proposal by Argentina and Brazil for the Establishment of a Developed Agenda for WIPO* (Aug. 27, 2004), *at* http://www.wipo.int/documents/en/document/govbody/wo_gb_ga_/pdf/wo_ga_31_11.pdf (last accessed Nov. 10, 2004) which suggests WIPO become more like UNCTAD.



That may be a product of negative cultural and political attitudes toward IPR protection in those countries which do not seem to have changed in the last few years as they appear to have in leading circles in China and India, for example. And since the vast majority of patents are never successfully exploited, the number of patents issued to inventors in a particular country are hardly direct evidence of reverse (i.e., "South-North") or omnidirectional tech transfer; however, it is certainly an indication that inventive activity of the highest quality in large developing countries such as China and India may increasingly "spill back" into industrialized countries such as the United States.[59]

CONCLUSION: REVERSE BRAIN-DRAIN AND THE LOGIC OF TECHNOSPACE

The "reverse brain drain" phenomenon, in which the "best and brightest" from overseas, trained in higher education in the United States, who formerly sought to stay permanently if they could and now choose to return to their home countries, has been much in the news of late.[60] Some countries have even established associations to encourage this return.[61] Quality of life, the

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59. *See*, *e.g.*, Greg Aharonian, *Future Inventions Will Happen Globally–No U.S. Preeminence*, PATNEWS (Feb. 18, 2004) (discussing the HP/Far Eastern Economic Review, East Asia Young Inventors Awards and recent U.S. "high-tech" patents emanating from China and Hong Kong, including U.S. Patent Nos.: 6,682,930; 6,660,157; 6,613,051; 6,605,565; 6,566,955; 6,525,513; 6,517,800; 6,485,909; and 6,407,990).

60. *See supra* note 27; Alan M. Webber, *Reverse Brain Drain Threatens US Economy*, USA TODAY, Feb. 24, 2004, at 13A.

61. *See*, *e.g.*, the Thailand government's "Reverse Brain Drain Project," *at* http://rbd.nstda.or.th/ (last visited Oct. 20, 2004); http://www.nectec.or.th/users/pong/RBD/

asperity of stringent U.S. visa requirements and "homeland security" oversight, closeness to family, religion, and familiar cuisine, nostalgia, Purchasing Power Parity cost of living disparities, and patriotism all play a role. This is merely to reiterate that the true essence of "intellectual property" is natural human creativity supported by public policy and investment (both public and private), the nurture of which may be either fostered or stifled by its political, economic, and social environment.

Such platitudes fail to address, however, the problems that face developing countries which are not so favored by the size of their markets, their natural resources, their education and social systems, or their latitude, and which still suffer "brain drain." Nor does it fully address the question of why the "best and brightest" who used to see Europe and the U.S. as "lands of opportunity" are now heading home. Perhaps regional solutions are preferable to global ones, and we are nearing the time when it will be possible to showcase countries such as China, India, and Korea–rather than just the U.S., Europe, and Japan–as the technology innovators of the coming century.

(last visited Oct. 20, 2004). China has an express policy of attempting to lure top emigré Chinese scientists from the U.S. to return to the mainland (sometimes in possession of a U.S. "green card").