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BACKGROUND AND EXPECTATIONS OF MIGRANT SCIENTISTS IN NORTH AMERICA*

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The institutional sources and academic qualifications of 553 scientists (mostly physicists and chemists) who had emigrated from Great Britain and Ireland to North America were ascertained by means of questionnaire A large proportion (34 per cent) had taken first class honours degrees Sixtyeight per cent of the scientists indicated they would remain permanently in North America, thirtytwo per cent saw themselves as temporary migrants The permanent migrant, as compared to the temporary one, was more likely to have come to the idea of emigrating on a previous visit to North America, he tended to be older, to have married a North American, to hold a permanent position in industry and to see himself as economically better off in America than in Europe

Some elite groups emigrate with little or no concern to their 'source' country A nation's future, for example, is unlikely to depend, in any significant way, upon the presence or absence of film and other entertainment personalities Poets, historians, machinists, nurses and domestics can leave a major country such as Britain for opportunities elsewhere without invoking much concern But the case of the natural scientists is another matter since it is widely believed that they are the negotiable currency which can be translated into national and international economic wealth and prestige While some scientists migrate because of political and social problems (1), a migration can also create political problems among nations, or at least, it can cause sufficient anxiety to warrant significant government interest and investigation (4, 7, 17) The actual impact of the emigration of scientists on the industrial health and economic wealth of the 'source' or 'sink' countries is however considerably in doubt, despite the work of such people as Grubel and Scott (6), Shearer (15), Johnson (8, 10), Patinkin (12) and Thomas (16)

There is no doubt that the prestige of a nation's scientific establishment

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tends to be weakened by the extensive permanent migration of scientists, although possible relationships which may exist between prestige, emigration, and the base number of scientists in a country at any one time are much less clear The material effects of such lowered prestige are also extremely difficult to assess one such possible effect is to reinforce the tendency to emigrate among other scientists (2, 9) Even though an eminent scientist may leave for idiosyncratic reasons, his departure may be interpreted as meaning that the conditions for his science are not as desirable as those in the destination country In fact, since scientists emigrate for the same personal (i e , non-professional) reasons that other people emigrate, the conditions for science in the new country need not even be as good as in the source country (18) While the economic effects of scientists and others migrating from one national industrial complex to a competing national industrial complex are not yet clear, Niland (10) has provided an empirical test of some theoretical advantages and disadvantages to source and sink countries The view of unilateral and 'competing' national industrial complexes may soon be seriously outmoded however if the concept and structure of the so-called 'multinational' corporation continues and expands as Servan-Schreiber (14) suggests

The purpose of this paper is, first of all, to present some data about the background of scientists who had emigrated from Britain and Ireland to North America, and secondly, to indicate some of the factors relating to their decision to emigrate and their reasons for either remaining in North America or for wishing to return to Europe Questionnaires were sent to 925 British and Irish emigrant scientists, 553 useable replies were received Most of the scientists were working in the mathematical-physical sciences, a small number of engineers were also included The majority of names were derived from the North American mailing lists of The Royal Institute of Chemistry, the British Institute of Physics and the Physical Society Approximately 80 per cent of the scientists were resident in the USA and 20 per cent in Canada in the summer of 1964 when the questionnaires were completed Portions of the statistical findings of this research have already been published (19, 20) All respondents do not necessarily fall into each category analyzed, nor have all respondents necessarily answered each item, therefore, the total number of responses differs from table to table

INSTITUTIONAL SOURCES AND QUALIFICATIONS OF THE EMIGRATING SCIENTISTS

It is generally accepted in the United Kingdom that the type of secondary school attended by students influences whether they will go to a university and, if they go, the type of university they will attend. The emigrating scientists are no exception. Table 1 shows the relationship between type of secondary school and the university from which the scientists took their terminal degree. More than the average number of public school boys went to Oxbridge, and more than the average number of grammar school boys went to Redbrick/ Scottish universities (χ^2: 7·28; *df*: 2; $p < 05$).

A large proportion of the total sample (34 per cent) took first class honours degrees, but there was variation among the types of universities in the proportions which took Firsts. Oxbridge graduates were more likely to have received first class honours degrees (50 per cent compared to 41 per cent for Redbrick/Scottish and 34 per cent for London University) but Redbrick/Scottish graduates were more likely to have won either a First or a Second.

Most of the migrant scientists took positions in the United Kingdom before departing for North America. Although there is a slight tendency for London University graduates to be in industrial positions before emigrating, the distribution for each university category resembles very

TABLE 1

TYPE OF SECONDARY SCHOOL ATTENDED RELATED TO TYPE OF UNIVERSITY FROM WHICH EMIGRANTS TOOK TERMINAL DEGREE

	Type of Secondary School		
Type of University	Public	Grammar	Total
London	44	113	157
Oxbridge	35	58	93
Redbrick/Scottish	43	149	192
TOTAL	122	320	442

TABLE 2

TYPE OF UNIVERSITY FROM WHICH EMIGRANTS TOOK TERMINAL DEGREE RELATED TO EMPLOYMENT SECTOR OF THEIR LAST POSITION BEFORE EMIGRATION

Employment Sector	Type of University			
	London	Oxbridge	Redbrick/Scottish	Total
Government	24	15	26	65
Industry	32	16	33	81
University Staff	36	23	41	100
University Student	32	26	56	114
Non-Profit Research Institution	13	12	20	45
TOTAL	137	92	176	405

closely the distribution of all scientists (see Table 2 for which the χ^2 value is 5·47, with *df*: 8).

The process whereby scientists in Europe decide to take positions in North America has not been fully explored. The pull of better facilities has been suggested as an important factor; so too has the possibility that many are pushed out of countries like Britain due to lack of room at the top. Whatever the processes involved, 77 per cent of those about whom

TABLE 3

LEVEL OF INCOME BEFORE EMIGRATION RELATED TO INITIATION OF NEGOTIATIONS FOR EMIGRANTS' NORTH AMERICAN POSITIONS

Who Initiated Negotiations	Income Level (in $2.80 pounds)					
	under 599	600-1299	1300-1799	1800-2499	2500+	Total
Scientist	122	179	52	32	7	391
Future Employer	31	39	20	18	8	117
TOTAL	153	218	72	50	15	508

information was available regarding the initiation of negotiations said that they themselves had initiated such negotiation The employment sector of their last position in Europe was not related to who began negotiations For example, whereas 17 per cent of the sample were in United Kingdom government positions, 16 per cent of those who themselves initiated negotiations for a North American position were also in government

Initiation of negotiations was related to income level, Table 3 shows the tendency for the higher income migrants to have been approached more often by future employers (χ^2 17 35, *df* 4, $p < 01$) This probably is because the higher salaried individuals are better known and thought to be of higher quality 'Foreign' recruitment is costly to employers, therefore, it is the better scientists who are actively recruited

Over sixty per cent of the scientists had changed employment sectors between their last position before emigration and their position at the time of the inquiry (Table 4) American universities in particular gained in these changes Closer examination of the background of the migrants

TABLE 4

DISTRIBUTION IN EMPLOYMENT SECTORS OF 453 EMIGRANT SCIENTISTS BEFORE AND AFTER EMIGRATION

Employment Sector	Before Emigration	After Emigration (1964)	Percentage Gain or Loss
Government	76	57	—4
Industry	99	163	+14
University Staff	110	194	+19
University Student	117	16	—22
Non-Profit Research Institution	51	23	—6
TOTAL	453	453	

shows that those who held civil service posts in Britain were more likely to go into industry in North America than into government posts Industrial scientists tended to stay in industry, a lesser number went to universities Academic scientists tended to stay in universities, but were also

prepared to go into industry Very few scientists who were full-time United Kingdom students were still students at the time of the inquiry, most had taken positions on university staffs and some had gone into industry Finally, scientists in non-profit research preferred the university sector to the industrial sector

FACTORS RELATING TO REMAINING OR RETURNING

When the scientists were asked whether or not they would stay in North America, 47 per cent indicated they were 'probably permanent', 21 per cent 'definitely permanent', 17 per cent 'probably temporary' and 15 per cent 'definitely temporary' Taking the permanent and the temporary migrants as two groups, we shall explore the factors which are related to their leaving or staying in North America These may be arbitrarily divided into personal, environmental, and economic categories

Personal

Four 'personal' factors are considered in relation to an emigrant's decision to stay in North America or to return to Europe (i) the source of the idea to emigrate in the first place, (ii) the emigrant scientist's age at the time of emigration, (iii) the length of time the decision to emigrate was considered, and (iv) the nationality of the emigrant's wife

Over 90 per cent of those who got the idea to emigrate as a result of a previous trip to North America said they would remain, while fewer than half who received the idea from their university teachers said they would remain Those scientists whose parents were the source of the idea are also very likely to remain (86 per cent said they would do so), although a very small minority of this group felt an element of parental rejection, most saw reluctant parental acquiescence to the push and/or pull factors the scientists themselves cited

Scientists who decided to emigrate at an early age are less likely to remain than those who reached the decision late in life There is a steady progression between the age at which the decision to emigrate was made and the probability of remaining in America Of those who decided to emigrate before the age of twenty-two, 66 per cent saw themselves as permanently settled in America For the age range 23-28, 70 per cent saw themselves as permanent emigrants, for ages 29-35, the figure was 83 per cent, for ages 35-41, 81 per cent and for those over 42 years of age, 86 per cent Presumably younger scientists like to believe they will have the opportunity to cross oceans several times before they settle down, whereas

older scientists may tend to make what they think of as being 'final' decisions

Results of our research also indicate that long periods of contemplation may be detrimental to the permanence of one's migration behaviour Whereas 77 per cent of those emigrants who thought about the decision six months or less are probably going to remain in North America, 66 per cent of those who thought about it over two years plan to stay It should be emphasized that asking this type of question about the past, calls for the reconstruction of processes dependent upon memory of mood and attitude and thus may be subject to severe variations And of course, the tendency for migrants to rationalize the past to justify the present is also a distinct possibility

The final personal factor considered here, the nationality of the emigrant scientist's wife, appears to be a very important one (See Table 5, for which χ^2 24 54, *df* 2, $p < 001$) A large majority (92 per cent) of the scientists with North American wives plan to remain, while only 66 per cent of the scientists with British wives intend to become permanent

TABLE 5

NATIONALITY OF EMIGRANTS' WIVES BY TYPE OF MIGRANT

Type of Migrant	British	Canadian or American	Any other	Total
Permanent	213	82	22	317
Temporary	112	7	12	131
TOTAL	325	89	34	448

North American residents While having a North American wife could be a central and causal factor for remaining, marriage to a local could also result from having already made a commitment to North America

Environmental

Three factors in the environment and their relationship to the decision to remain in North America are considered (i) whether the type of position in which a scientist works is permanent or temporary, (ii) his employment sector, and (iii) whether or not he has fulfilled his professional expectations The last factor is somewhat personal, to be sure, but we

assume it is the interaction between himself and his perceived scientific environment which results in his evaluation of professional expectations

One would expect the permanency of a scientist's position to be related to his intention to remain in North America, and this is in fact so Based on 546 responses, 81 per cent (329 out of 407) of those with permanent positions intend to remain in North America, whereas only 32 per cent with temporary work so intend The decision to remain, however, is not confined to those with permanent positions, some scientists apparently decide to remain and then seek permanent, or even temporary positions, much as native North Americans frequently accept 'temporary' positions such as post-doctoral fellowships Those with temporary positions who plan to remain must be regarded as having a strong desire to do so, because eventually they will be forced to find other positions

While approximately 70 per cent of the sample plans to remain, the percentage increases to 81 per cent in the case of scientists who hold a permanent position But if the scientists have also fulfilled their professional expectations, the percentage further increases to 86 per cent Even those in permanent positions who have not fulfilled their expectations are more likely to stay than those in temporary positions who have fulfilled their expectations When we consider fulfilment of professional expectations by employment sector and the probability of staying in North America, we find that the industrial sector ranks first in the proportion of those who plan to remain, but ranks second in the fulfilment of professional expectations There is little variation by sector as to the fulfilment of expectations, however, and the distribution largely reflects the sample distribution Because one of the major political considerations in the brain drain phenomenon involves the United Kingdom's contribution to rival industrial economies, this analysis by sector is significant—it indicates that the largest group of scientists who return to Europe (91 out of 138) will be university staff *

Altogether, over 40 per cent of the emigrant scientists in North America would welcome job offers from Britain Of the 'permanent' residents, 28 per cent would welcome an offer, 33 per cent would not and 39 per cent were uncertain Of the 'temporary' residents, 77 per cent would welcome an offer, 5 per cent would not and 18 per cent were

*Because the science faculties of British universities, in terms of student population, seem to be falling behind the general student population due to faster growing shifts into other faculties (5), it is interesting to speculate whether the 91 university staff members and at least some of the 17 student scientists have, in fact, returned This will be known later when follow-up studies are completed

uncertain The difference between the numbers of permanent and temporary US residents who would welcome the offer of a position in Britain is significant (χ^2 107 57, *df* 2, $p < 001$) Of course, this interest in receiving job offers from Britain could simply mean that scientists would like to feel wanted or to be complimented by a job offer which they could ultimately reject We believe, however, that some would return to Britain if the right position was offered

Scientists on university staffs are the ones most likely to welcome United Kingdom jobs, university students come next, and then scientists in industry While emigrant scientists working in North American industry are not the most likely to welcome a job offer, at least 38 per cent would do so, and quite a large number are uncertain Anyone who is 'uncertain' is not likely to disregard an offer The 'non-profit research' institution scientists are the happiest with their conditions and the government scientists are the most 'uncertain' apart from students who perhaps see their PhD or post-doctoral education plans being 'upset' by having to reach a decision to remain or go before completing their educational programmes Present-day British economic and social conditions differ from those in 1964 and would, no doubt, have some impact on scientists' willingness to return today There is some evidence that recent cuts in United States armament programmes, the air-frame industry and aerospace programmes, coupled with reduced budgets for primary research in the universities, has increased the number of British scientists seeking to return to Britain (Contemporary social conditions in the United States may also be a contributing factor) Anthony Wedgwood Benn, Minister of Technology in a previous British government, has said, 'there is no shortage of scientists in Great Britain We have been flooded with applications back from America (13)'

Economic

The emigrant scientists earn considerably more money in North America than they did in the United Kingdom The average Umted Kingdom salary of the hard scientists (excluding students) before emigrating was £1,276 per annum The median salary in North America (summer 1964) was more than $10,000 and less than $12,500 (18)

Because purchasing power is more important than gross income, we sought for possible differences in how temporary and permanent migrants perceived the value of the dollar Migrants were asked to estimate the number of dollars necessary to equal one pound sterling in buying value The fewer dollars a scientist estimated as necessary to equal a pound (in

real goods and services), the more likely he was to remain in North America Perhaps the migrants tend to perceive the cost-of-living through the psychological prism of their expectation to return, as opposed to the obvious economic explanation that they intend to return due to the 'high cost-of-living' in North America That they live in different geographic regions of North America with varying costs-of-living seems inadequate to account for the strong relationship between dollar-pound equivalents and their decisions whether or not to stay in North America, even if cost-of-living is seen as the central factor, it would be a naive scientist who was unaware of other areas with considerably lower living costs.

Comparing the scientists' own hypothetical estimated United Kingdom income to their 1964 North American income, we find that of the scientists making over $18,500 in North America, 70 per cent of them feel they would be making less than £3,500 if they returned to a United Kingdom position At almost any exchange rate, that is a substantially smaller salary, and they made their estimations on the basis of a pound sterling being equal to $2 80

CONCLUSION

A world market for natural scientists exists and has tended to become a factor in the individual science policies of Western nations Increasingly, those concerned with science-policy within a given country must be aware of the conditions for science in other countries, including the state of the market based upon such factors as government and private expenditures for research, university expansion plans, military spending, and industrial research and development It has become more and more difficult for Western nations to make unilateral decisions concerning scientific education, funding of research, and the structure of the scientific establishment and policies within those structures without paying attention to the policies of other countries to which scientists may migrate

The scientific personnel of any country are constantly at risk, this is especially true of the best scientists Scientists, at their best, are a standardized product, and being standardized, are free to respond to better conditions for their science elsewhere It is not enough merely to subsidize the education of scientists and to hire them at the going wage within the country's economic system, to do so without adequate attention to conditions elsewhere may be merely to programme scientists for emigration This appears to be true of the British physician, as well (3) After producing a scientist or physician, his absorption and retention in the

economy and professional life of the country must be carefully planned along lines which are competitive in relation to conditions for professionals elsewhere A one-to-one relationship is not required, but the lack of some approximation will most likely be accompanied by increasing rates of migration

In this study, we have identified some of the characteristics of migrant scientists and some of the factors relating to their continued residence in North America These characteristics, and the use of some system of incentives which capitalizes on them, should be of considerable interest both to those persons involved in the attraction and recruitment of migrant British and other scientists and to those who seek to retain or regain them They should also be of interest to those science-policy officers in government whose concern it is to form a public policy which will be dedicated to the strengthening of the national science establishment without placing unnecessary and undue strain on the scientific manpower supply of friendly nations

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