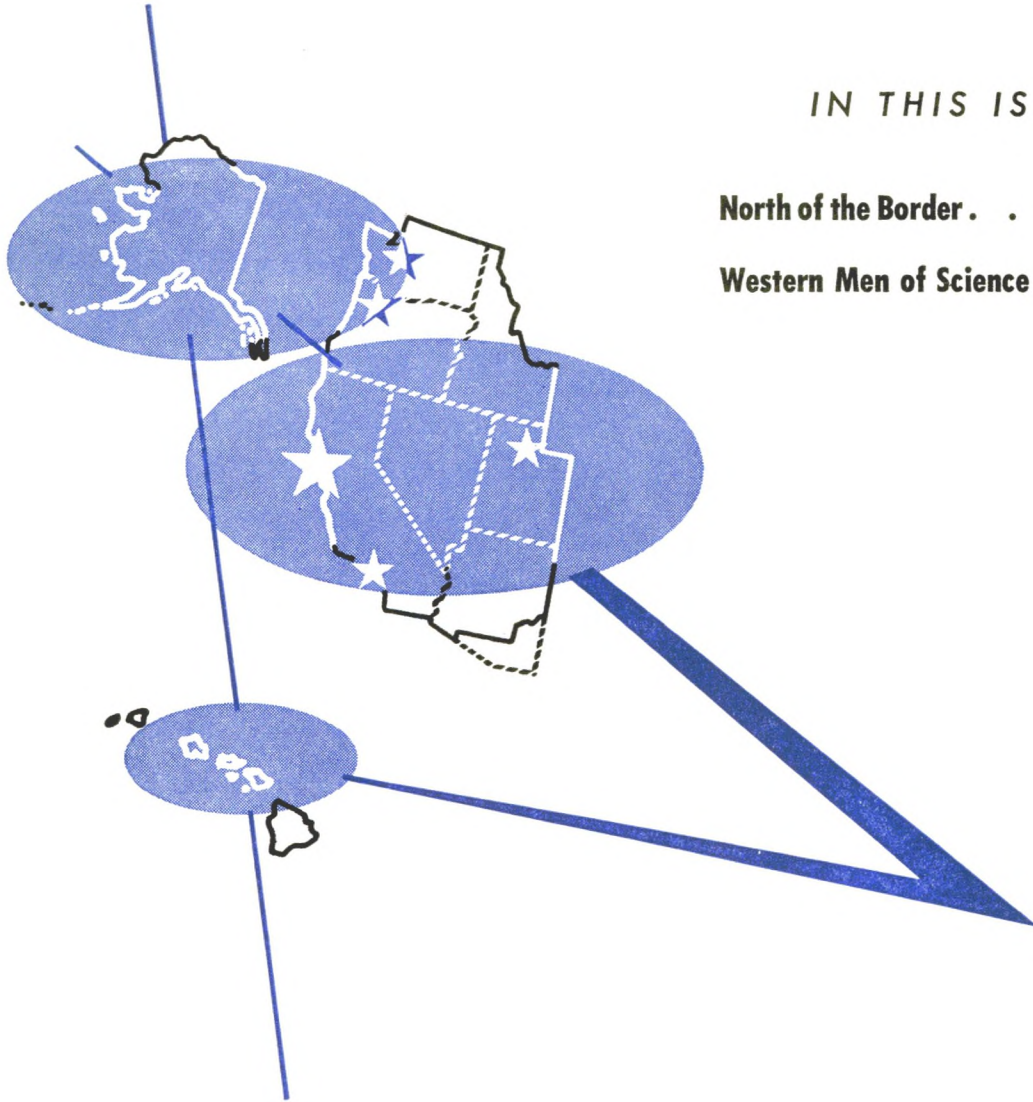


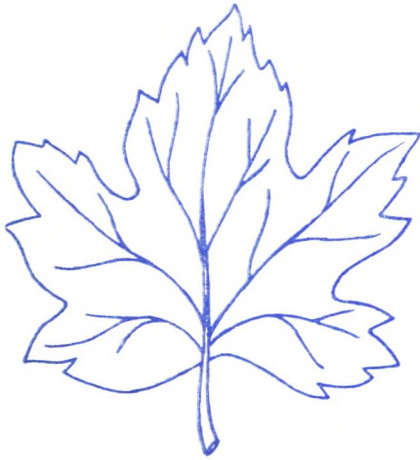
# MONTHLY REVIEW



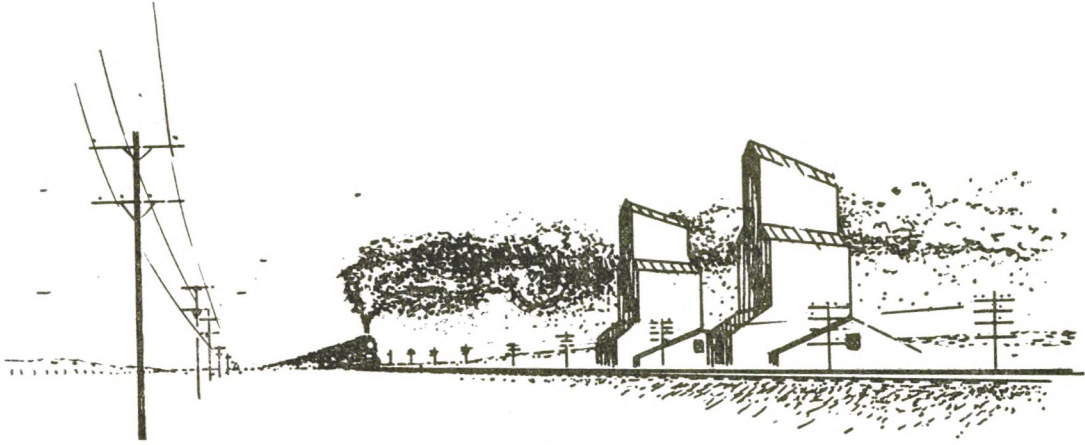
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**MARCH  
1964**



**Canada . . .**



## North of the Border

**M**OST Americans are aware of Canada as a vacation spot, the home of the red-coated Royal Canadian Mounted Police, and a land of adventure where Jack London characters abound. We are also aware that we have shared with Canada for more than 100 years a common, unprotected border stretching almost 4,000 miles from the Atlantic to the Pacific Oceans. Despite the fact that Canada has been an independent member of the British Commonwealth of Nations since 1867, we in this country feel a close kinship with our neighbors to the north and share many of the same interests and tastes. This kinship is heightened by the fact that English is the principal language in Canada, although the country is officially bi-lingual and one-third of the population is of French extraction.

In the area bordering on each side of the international boundary, moreover, topography, climate, resources, and products are quite similar, and substantial trade is carried on between the two border regions. Over the years, the economic ties between Canada and the United States have strengthened—even to the point of speculation about an economic union in the distant future. The two nations, in addition, have worked together closely on the international political scene.

This similarity of economic and political interests leads many people to take Canada somewhat for granted, so that its problems tend to be overlooked until some major event appears to encroach on U. S. interests. Such an event occurred in May 1962, when Canada devalued its dollar and returned to a system of fixed exchange rates. Since that time, Canada has received more notice in this country as befitting a country of its size and economic and political importance.

Canada, after all, is the second largest country in area in the world (next to the Soviet Union), a leading producer of primary commodities, and the Western World's fourth most important trading nation. According to the latest figures available, Canada is the world's leading producer of newsprint, wood-pulp, nickel, and asbestos; the second most important in production of platinum, gold, aluminum, zinc, uranium, and hydroelectric power; third in wheat, lead, silver, and molybdenum; and fourth in lumber, copper, and iron. Canada's population, however, is only one-tenth as large as that of the United States and is concentrated mainly in a strip within 200 miles of the international border.

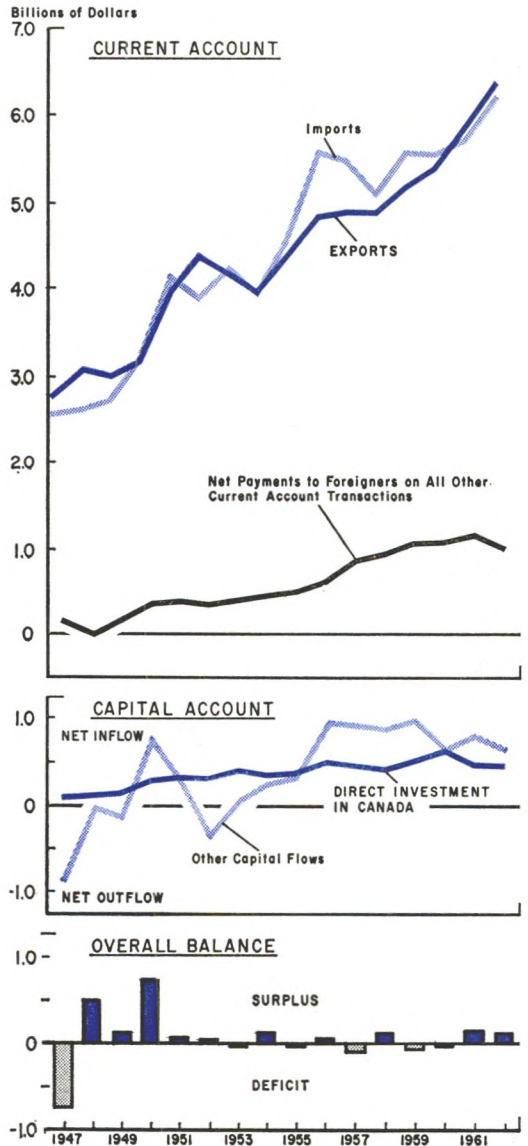
### Devaluation in limelight

Canada's decision to devalue its currency was motivated principally by the fact that the premium on the Canadian dollar, caused by substantial inflows of foreign capital, had stimulated imports but had worked to the disadvantage of Canadian exports. The resultant deficit on current account transactions was largely responsible for the Canadian balance of payments deficits. Customarily, a trade deficit with the United States had been partly offset by a surplus in trade with other countries, principally the United Kingdom and the rest of the sterling area. But even a trade deficit of this size was undesirable in face of the steadily growing deficit on non-merchandise transactions caused by rising interest and dividend payments on foreign investments in Canada and rising (net) payments to foreigners for travel and transportation. The movement of short- and long-term funds into Canada, however, had for some years offset the current account deficit and masked the underlying weakness of the nation's domestic and international position. As a consequence, steps to reduce the current account deficit were not undertaken.

Then, in June 1961, Canadian policymakers moved to influence the rate for the Canadian dollar in a downward direction, by announcing the Government's intention to push the rate for the Canadian dollar to a discount against the U. S. dollar. This declaration of official intent subsequently resulted in speculative pressures against the Canadian dollar, which eventually necessitated sizable official support operations and resulted in large reserve losses, especially from December 1961 through April 1962. Early in May 1962, the decision was reached to peg the Canadian dollar at 92.5 cents in terms of the U. S. dollar, under the rules of the International Monetary Fund. Nevertheless, Canada's ability to maintain the rate at this lower level remained in question, and speculation continued until

June 1962, when massive international financial assistance totaling more than \$1 billion was mobilized and the central bank discount rate was boosted to a crisis level of 6 percent.

### Canada shows improvement in current accounts balance as capital inflows level off



Source: Bank of Canada.

### Now more vulnerable?

Since abandonment of the freely fluctuating exchange rate for the Canadian dollar, the Canadian domestic economy has been more vulnerable to economic developments abroad. Developments in the United States, in particular, have tended to provoke repercussions in Canada because of the close links between the two countries. Canadian policies designed to bring its payments position into better balance and to step up its economic growth rate in turn have affected this country. To check the inflow of foreign capital, which comes mainly from the United States, Canada has proposed more favorable tax treatment for "Canadian" industries (defined as industries 25 percent or more Canadian-owned) and has abolished preferential tax treatment of dividend and interest payments to foreigners. At the same time, the United States—in attempting to correct its payments imbalance—has proposed a tax on U. S. investor purchases of foreign securities.

The introduction of the proposed interest-equalization tax in July of last year hit Canada particularly hard, since it has been a consistently heavy borrower in the U.S. capital market. Although Canada was assured that its new security issues in the United States would be exempt from the tax as long as the proceeds were not used to build up Canadian international reserves, the Canadian securities markets were unsettled by the surprise U. S. action. Canada consequently felt impelled to raise its discount rate from 3½ to 4 percent early in August, wiping out the covered spread in favor of short-term investment in the United States that had emerged when the Federal Reserve Banks upped their discount rates from 3 to 3½ percent in July.

Subsequently, Canada extended its system of tariff rebates on automobile transmissions (introduced in late 1962) to imports of all automobiles and parts, based on an equivalent dollar volume of exports of automobiles and

parts. This action alone may increase Canadian exports in this category by some \$200 million, mainly to the United States. Although this move was part of the program to strengthen Canada's secondary manufacturing base and to expand markets for Canadian products on a continental basis, it also tended to reduce our trade surplus with Canada and thus complicated our efforts to reduce our own payments deficit.

This capsule history serves to demonstrate the importance to each other of the interlocked Canadian and American economies. To some extent, the two countries have been faced with similar problems—high unemployment, excess productive capacity, and balance of payments problems. As a consequence, the policy requirements for stimulating economic growth have seemed to conflict with policies essential for better payments equilibrium. But here the parallel ends. The factors behind the emergence of these problems are different for the two countries, and their interactions present an additional dimension which must be considered by their policy-makers. Since the United States plays a more important role in the Canadian economy than Canada does in the United States, a closer look from the Canadian viewpoint might be useful.

### Importance of trade

The Canadian economy is based largely on an abundance of natural resources—which are most economically and efficiently exploited where large scale production is possible and access to world markets is unobstructed—and foreign demand for the products of Canadian forests, mines, and farms therefore is an important economic variable. Exports of goods and services from Canada account for about one-fifth of Canada's national product, almost four times as much as in the United States. Exports of goods alone account for 40 percent of total Canadian output of movable goods.

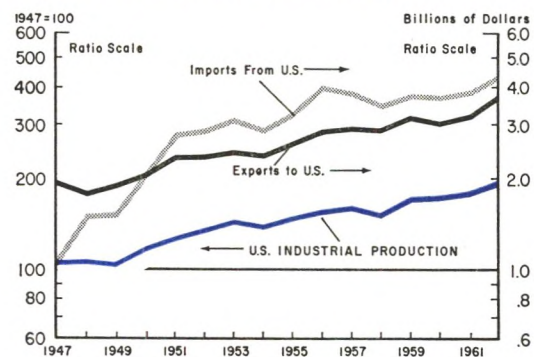
The level of exports is one of the principal determinants of Canadian income, employment, and investment. When export demand for Canadian products is strong, domestic investment rises in order to provide the additional capacity needed to meet prospective increases in foreign demand. Internally generated capital is supplemented by foreign capital whenever demand is particularly high and domestic savings inadequate, and much of this foreign capital is transferred in the form of goods and services. Larger export receipts and capital expenditures lead in turn to higher levels of domestic consumption and employment as the effect of the initial stimulus from higher exports spreads throughout the economy. As foreign exchange earnings increase, the ability of Canada to import foreign products—either in the form of consumer goods or capital equipment—also rises. When export demand contracts, the reverse occurs: income, employment, investment, and imports decline and the inflow of foreign capital falls off significantly.

Because many of its exports are industrial raw materials, the Canadian economy is especially sensitive to production trends abroad, particularly in the industrialized countries. Its food exports, meanwhile, vary with the outcome of harvests abroad. Canadian export earnings, however, tend to be more stable than those of most other primary producing countries because of the country's greater economic diversification, its use of long-term contracts, its maintenance of competitiveness, and the strong secular growth in demand for certain Canadian products.

### Importance of the United States

The tempo of business activity in the United States is a major influence on the Canadian economy. This country has come to occupy an increasingly important role as the leading purchaser of Canadian exports and the leading supplier of Canadian imports,

### Canadian exports reflect shifts in U. S. industrial production; imports reflect export earnings



Sources: Bank of Canada; Board of Governors of the Federal Reserve System.

partly because of wartime developments which weakened Canadian ties with the United Kingdom and partly because of the rapid postwar growth in American industrial material requirements. The U. S. share of Canadian exports has risen from an average of 36 percent in the 1936-39 period to 60 percent today, while our share of Canadian imports has risen from an already high level of 62 percent in the prewar period to almost 70 percent recently.

Increased trade has been accompanied by a rise in service and capital transactions in both directions. A huge influx of American and other foreign capital for expansion of productive facilities was stimulated a decade ago by the Paley resources report, which aroused fears of future shortages of major industrial materials in the face of strongly rising demands. In the 1950's, foreign capital—in the form of new capital inflows, reinvested earnings, and depreciation reserves—accounted for almost 30 percent of Canada's gross capital formation. The net result of these developments was a sharp rise in the relative importance of the United States in Canadian international transactions.

Reliance on the export sector has created a number of problems for Canada, which are

partly alleviated by the fact that much of Canada's exports to the United States—its principal market—do not fluctuate significantly over the business cycle. Nevertheless, weakness in export demand—due to increasing competition from other primary producers and a slower rate of growth in world markets for industrial materials and foods—has had unfavorable repercussions on the rate of Canada's economic growth. The increasing diversification of the domestic economy and the poor competitive performance of many Canadian manufactured products in foreign markets—despite the favorable short-term effects of devaluation—also have reduced the relative importance of the export sector and thus its stimulating influence on the domestic economy.

Imports, on the other hand, have tended to vary with domestic economic activity and are highly responsive to changes in the level of domestic income. Small price changes have relatively little impact on import volume, since a significant proportion of Canadian imports consists of products not manufactured domestically or of component parts imported for further fabrication and assembly by Canadian subsidiaries of U. S. concerns. Consequently, the devaluation of the Canadian dollar has not been fully reflected in a commensurate decline in Canadian imports. There has been some displacement of imports by domestic production, however, which has offset part of the impact of higher prices on import volume.

### **Can trade surplus be sustained?**

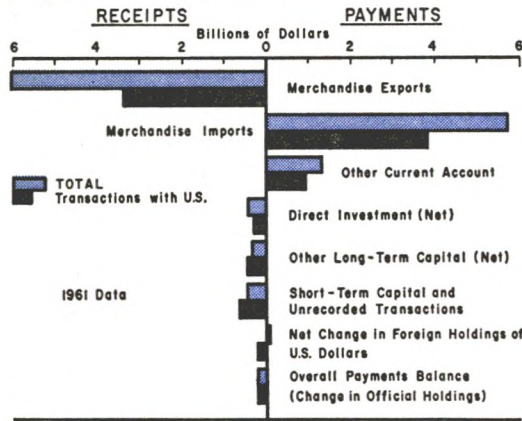
The prospects for enlarging Canada's trade surplus, which has emerged only within the past three years as a consequence of depreciation and the revival of export demand, are somewhat uncertain. The large wheat shipments to the Soviet Union contributed to the improvement in Canadian exports in 1963, but these must be considered a temporary phenomenon. Exports jumped almost 10 per-

cent last year, while imports rose at only half that rate. The expansion of exports to countries other than our own of course minimizes the adverse impact on the United States of a larger Canadian export surplus. The United Kingdom and some of the European Common Market countries, however, are now registering growing trade deficits which they would be reluctant to widen.

Continued high levels of economic activity in the industrialized countries (especially the United States) may permit Canada to realize its goal of increased exports. The reversal of Canada's earlier policy against electric power exports also may contribute to export expansion. (The impact on the United States will be kept to a minimum if the over-all rise in imports from Canada is not matched by a net outflow of capital to Canada.) Special measures, such as the rebate of import duties on automobiles and parts, might boost exports, but might also have undesirable repercussions on American trade. Then again, the path of export expansion is still blocked by various obstacles such as protectionist agricultural policies abroad.

Canadian imports, meanwhile, probably could be held close to current levels despite the fact that import demand in Canada is more responsive to rising domestic economic activity than it is in the United States. Domestic production might be expanded with relatively little pressure on costs and prices through encouragement of secondary manufacturing and utilization of unemployed manpower resources and existing excess plant capacity. U. S. manufacturers, however, should be able to hold their own in Canadian markets, since Canadian industry is not yet fully geared to meet domestic requirements for capital and consumer goods—and since Canadian consumers still hold decided preferences for U. S. brand names and products.

**U. S. accounts for bulk of Canadian payments transactions**



Source: Bank of Canada.

**Why trade surplus is necessary**

The necessity for a larger Canadian merchandise trade surplus arises from the steady uptrend of net payments to foreigners on so-called "invisible" transactions, including tourist expenditures, transportation, interest and dividends and payments for business services. Some progress has been made toward reducing the import bill for tourism and travel, but all these transactions tend to be largely unresponsive to changes in government policy as well as increasingly insensitive to variations in economic activity over the business cycle. Lack of response, particularly in the contractive phases of the cycle, tends to reinforce the dangers of a net outflow of capital to foreign countries during a downswing in Canadian economic activity.

Net interest and dividend payments to foreigners, which totaled over \$550 million in 1962, attract a great deal of attention because they arise from the sizable foreign investments made in Canada. Although foreign direct investment in Canada seems to be leveling off, investment income payments to foreigners are expected to rise at a steady pace as completed projects begin to show profits and as servicing of earlier investments continues. But, now, as

part of its program to develop a more strongly Canadian-oriented economy, Canada is trying to discourage such investment through discriminatory taxation of foreigners' investment income or through preferential treatment for dividend and interest payments of Canadian-controlled firms.

Some observers have claimed, on the basis of the fact that U. S. firms control more than two-fifths of Canadian manufacturing facilities, that Canadian subsidiaries of American companies have subordinated Canadian interests to those of their parents. Admittedly, the percentage of U. S. ownership rises as high as 95 percent in the automobile industry, 90 percent in rubber products, and almost three-fourths in the petroleum and natural gas industry. U. S. investments also are sizable in electrical apparatus, chemicals, pulp and paper, and mining and smelting. But citing these figures does not prove the claim. Canada accounts for approximately one-third of this country's total direct investments abroad, but these investments have benefited American manufacturers primarily by providing them with assured access to foreign raw material supplies and to Canadian markets for consumer and industrial goods.

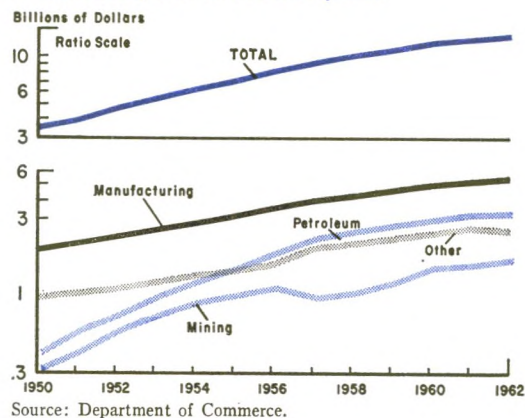
A declining level of U. S. direct investment in Canada should assist the American balance of payments over the short run because investment income will continue to rise, although exports to Canada may decline. Over the longer run, direct investments may not increase as rapidly as in the past because Canadian export capacity is now ample in many lines of production and should remain so for some time to come.

**Other complicating inflows**

Portfolio investment in Canada has been influenced by yet another set of factors. Canadian corporations and governmental units have made sizable borrowings in the U. S. capital market, primarily because of a short-



### U. S. expands direct investments in Canada, but at slower pace



age of domestic capital. Lower costs of flotation have been a relatively minor factor, although there seems to be some correlation between the volume of corporate borrowing and the differential cost of borrowing in the two countries. The development of capital market facilities broad enough to supply all of Canada's domestic requirements has been held back by heavy dependence on foreign capital during the nation's formative years, by a relatively low level of domestic saving, and by practically unrestricted access to the U. S. capital market—at least prior to the interest equalization tax proposal.

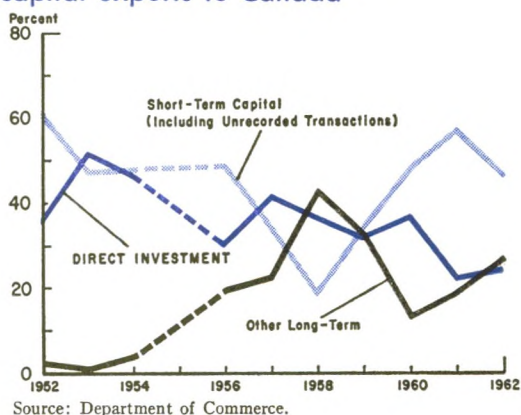
In the past, most of the capital inflow from the United States to Canada helped to finance Canadian imports of goods and services as well as part of the deficit on nonmerchandise transactions with other countries. To the extent that capital exports from the United States were not accompanied by exports of goods and services, our balance of payments suffered. Under present circumstances, when the United States is engaged in a major effort to reduce its payments deficit, any contribution to a reduction of dollar drains—from this source or other sources—would be welcome.

A shift in recent years in the nature of long-term borrowing by Canadians in the U. S.

capital market has increased the significance of this type of capital export for our balance of payments. Provincial and municipal government expenditures in Canada for social capital purposes (such as school construction, highways, and public utilities) are rising at a rapid pace and are being met only in part from domestic sources of financing. The remainder must be obtained through recourse to foreign capital markets. But this type of expenditure is less likely than other types to result in the direct export of goods and services from the United States, and thus it is more likely to worsen our payments position.

A further complicating feature of private capital flows between Canada and the United States is the rising relative importance of short-term capital. The sensitivity of short-term capital to interest rate differentials tends to reduce the flexibility of monetary and debt management policies in the countries involved and to increase the significance to each country of policy changes in the other. Although only certain types of short-term capital flows are responsive to interest rate spreads, the existence of a large volume of relatively volatile funds poses the threat of fairly sizable capital flows. Economic and political stability

### Short-term funds, other long-term capital gain importance in U. S. capital exports to Canada



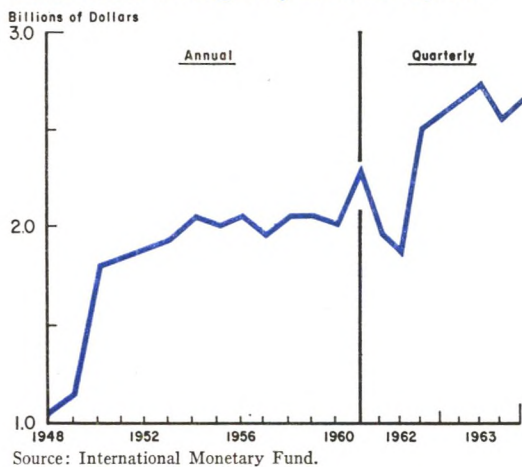
in the United States and Canada, moreover, increases the volume of funds susceptible to the lure of more attractive investment opportunities in the other country whenever they appear.

Both interest rate differentials and relative profit prospects reflect relative rates of economic growth—in this case, in the United States and Canada. In particular, merchandise trade, the current account balance, and direct investments mirror the assessments by the market of the economic outlook in the two countries. Price relationships do not appear to play a major role in trade between them. On the other hand, because of the greater economic importance of the United States in Canada's balance of payments, developments here tend to exert a greater influence on the Canadian economy than Canada does on us, although there is some evidence that Canada is becoming somewhat less dependent on the United States than heretofore—and less dependent particularly during the expansionary phase of the business cycle. Canadian policies and actions, nonetheless, are still able to make a strong impression on this country—as recent events so well attest.

### A two-year upsurge

Despite devaluation of the Canadian dollar in May 1962 and the accompanying disturbances, the Canadian economy's growth record in 1962 was one of the best since the mid-Fifties. Gross national product rose 8 percent, and the unemployment rate fell to 6 percent, around its lowest level for the preceding three-year period. The emergency program adopted during the exchange crisis succeeded in restoring confidence in the Canadian economy, and economic activity picked up. By October 1962, the reserve losses incurred during speculation against the Canadian dollar had been completely recovered. Strengthening of Canada's international reserve posi-

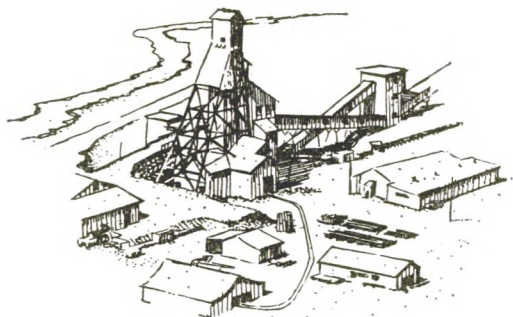
### Canadian reserves remain high after most emergency credits repaid



tion facilitated the lowering of the central bank discount rate in three steps during September-November to 4 percent, and thereby encouraged the resumption of domestic economic expansion. At the same time, the import surcharges imposed in June were gradually removed. By the end of 1962, much of the international financial assistance had been repaid; by the end of March 1963, the import surcharges had been completely removed; and by May the central bank discount rate returned to the pre-crisis level of 3.5 percent. (As already noted, however, the rate rose to 4 percent again in August.)

The rate of economic growth, nevertheless, seemed to lack vigor, and the hard core of unemployment seemed intractable. In the final quarter of 1962, despite a sharp improvement in Canada's trade balance—due largely to the devaluation—economic activity leveled off. Business began to revive early in 1963, however, and the expansion has since continued robustly, interrupted only by a mid-summer lull. By the end of 1963, the seasonally adjusted unemployment rate had fallen to 5 percent, the lowest level since mid-1957.

Canada's balance of payments responded favorably and rapidly to the exchange meas-



ures of 1962 and moved into surplus, due to a significant improvement in merchandise trade transactions and sizable long-term borrowing abroad. Occasional pressures on the Canadian dollar, produced by the Canadian budget message of June 1963 and by President Kennedy's interest equalization tax proposal in July, were weathered with little difficulty but with some loss of reserves. Canadian exports have subsequently been bolstered by the large wheat sales to the Soviet Union, while the rise in imports has been slowed.

### Problems for Canada

The Canadian economy, nevertheless, may soon encounter cost and price pressures and production bottlenecks. The competitive position of Canadian producers, which has improved as a consequence of devaluation and the relative stability of Canadian prices, may be weakened, and further progress may be harder to achieve. In view of a decline in capital imports from the United States and a slower rate of export expansion, Canada's economy may not be able to match the satisfactory performance record of the past two years. Rising productivity and ample sources of energy, however, are plus factors in the outlook.

Unemployment in Canada tends to average somewhat higher than in other industrial countries because of the wide dispersion of the population across the continent and great extremes of climate, which have a strong seas-

onal influence on the level of domestic economic activity. Although high unemployment can be attributed partly to weakness of aggregate demand, reinforced until recently by high public preference for cash because of inflation fears, the Canadian jobless problem contains some structural elements. In particular, the unemployed are heavily concentrated in the declining fields of agriculture, mining, forestry, and construction and among the less skilled and less educated groups.

Canada has other problems to solve as well. Domestic saving tends to fall short of domestic requirements, but active fostering of domestic money and capital markets may help to remedy this lack. Gross domestic investment in Canada, which has been among the highest in the Western World, is declining in importance and, as a consequence, plays a less vital role in stimulating economic activity than heretofore. A substitute to replace the impetus to the economy from this source therefore must be found. Finally, the considerable slack in Canadian productive capacity must be taken up by increased demand before new investment can be profitably undertaken.

### Problems for the United States

The success of Canadian efforts to achieve an equilibrium position in its balance of payments and to step up a hitherto sluggish rate of economic growth is of great importance to the United States. If fluctuations in the Canadian balance of payments do not react adversely on the United States, we should be far better able to correct our own payments balance and stimulate our own economic growth.



On the other hand, the U. S. payments position could be worsened by pegging of the Canadian exchange rate at a discount from the U. S. dollar and by Canada's need for larger international reserves under a fixed exchange rate system.

The economic ties between Canada and the United States will remain close, because of the meshing of consumption and income effects of transactions between the two countries and because of the difficulties involved in the expansion of markets elsewhere for

Canadian products. The tariff reductions that may be negotiated under the Trade Expansion Act will be of little benefit to Canada because the principal commodities affected will be mainly manufactured products, which account for only 10 percent of Canadian exports, rather than the low-tariff or duty-free industrial materials exported by Canada. But whatever happens, observers on both sides of the border are apt to remain acutely conscious of the fact that economic influences flow south as well as north.

## Canada and District

**T**HE close interrelationships between Canada and the United States on a nationwide basis and their implications for national economic policy are not without parallel in the Twelfth District. Not only do a number of District industries—such as pulp and paper—rely heavily on Canadian raw-material supplies, but financial institutions in Canada and in the District handle a sizable volume of trade and financial transactions between Canada and the United States.

The economic linkage between the Twelfth District and Canada is at the same time complementary and competitive. Industries in the Pacific Northwest and California, for example, have been using Canadian natural gas for several years, and plans have been made to extend the pipeline network for Canadian petroleum products even further into the District. On the other hand, District lumber producers compete with Western Canada lumber producers, not only in foreign markets but in U. S. eastern seaboard markets as well.

## Western Men of Science

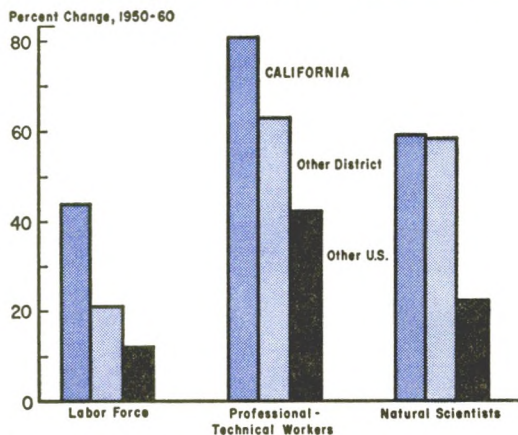
**P**ERSONNEL men and manpower experts have said a great deal—much of it unprintable—about scientific research workers, but all agree that the problems of recruiting and utilizing trained scientific manpower are quite minor in comparison with the problems which would result from attempting to do without this scarce resource. The well-stocked research laboratory more and more is regarded as an economic necessity, either in the competition to reach the moon or in the more prosaic competition for earthbound markets.

Since the areas and the industries with the most brainpower are likely to be the pacesetters in this typically Twentieth-century competition, the ability to train and to attract scientists promises to be a prime determinant of future business success. From the evidence to date, which shows a striking success for the West in the nationwide (and even worldwide) talent search, this area's future should be bright indeed.

The growth in the West's labor force, of course, has been strikingly large in all sectors but nowhere so large as in the scientific and professional categories. Between 1950 and 1960, when the civilian labor force increased 36 percent in Twelfth District States (as opposed to 12 percent elsewhere in the nation), the District recorded a 75 percent gain in professional and technical workers and a 59 percent gain in natural scientists alone. In 1960, the District accounted for less than 14 percent of the civilian labor force but for 17 percent of all the natural scientists in the nation. California alone accounted for more than 11 percent of the nation's scientists, and other District States accounted for another 5½ percent—and, if anything, those proportions have increased since 1960.

In some fields, especially chemistry and biology, the West's share of the national total has not been disproportionately large. In other

### Scientists, technicians increase more rapidly in West than elsewhere



Source: Bureau of the Census.

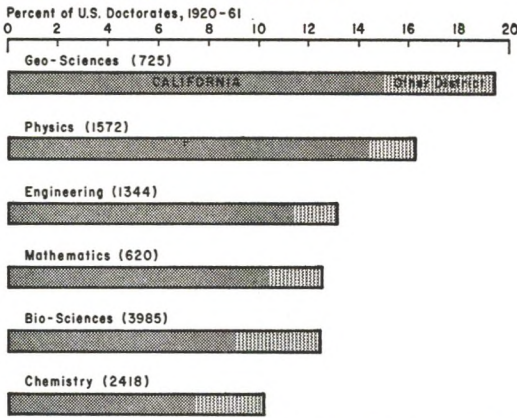
fields, however, the picture is quite different. California alone boasted 17 percent of the nation's physicists, 16 percent of its mathematicians, and 11 percent of its geologists, in the 1960 Census year. Other District States, meanwhile, accounted at that time for 19 percent of the nation's agricultural scientists.

### 1876, not 1776

The crucial role played by scientists, both here and elsewhere in the nation, can be traced in large part to the manner in which scientific innovators and industrial leaders have been trained throughout the past century. Modern industry undoubtedly would be much different—and probably less advanced—if the nation's universities throughout this period had not emphasized scientific training, the research method, and the empirical application of scientific advances to industrial problems. Science may well be (as T. H. Huxley described it) “nothing but trained and organized common sense,” but the manner of training and organizing has proven crucial for economic growth.

The year 1876—the date of the founding

## West produces disproportionate share of nation's scientists



Note: Figures in parentheses refer to total numbers of doctorates awarded in Twelfth District states in 1920-61 period.  
 Source: National Academy of Sciences—National Research Council.

of the first graduate school (Johns Hopkins)—by these standards may be more meaningful for Twentieth-century society than even 1776. When that school opened its doors, its founder declared that graduate education presaged “less misery among the poor, less ignorance in the schools, less bigotry in the temple, less suffering in the hospital, less fraud in business, less folly in politics; and, among other things, more security in property, more health in cities, more virtue in the country, more wisdom in legislation, more intelligence, more happiness, more religion.” Some of these goals, of course, still remain unfulfilled. What has been achieved, however, is a vast increase in the number of research workers capable both of achieving scientific breakthroughs and of applying these breakthroughs to industrial progress.

The graduate school emphasis on scientific research led to the production of 84,000 Ph.D.’s in natural science in the 1920-1961 period. In the 1920’s, the nation’s universities produced an average of almost 600 scientists annually in such specialties as physics, chemistry, geology, and biology. In the 1940’s they produced about 1,550 scientists annual-

ly, and by the 1960-1961 period they had increased their annual production to about 5,000. (Substantial increases also occurred, of course, in the production of scientists with M.S. and B.S. degrees.)

The expansion in production of scientists took place in the face of a slight shift in emphasis in graduate education over the forty-year period. Between the 1920’s and the early 1960’s, the natural sciences’ share of total doctorate production dropped from 49.2 to 48.0 percent. Some other fields also declined in relative importance—the social sciences slightly, the humanities precipitously—while the production of doctorates in the field of education increased from 9.6 to 16.4 percent of the total. Nonetheless, the universities’ eight-fold expansion of skilled scientific manpower during this period evidenced their success in fulfilling their task of supporting science.

The West’s graduate schools have continually produced more than their share of the Ph.D.’s in the natural sciences, and thus they account to a large extent for the West’s disproportionate share of the nation’s scientific manpower. Over the 1920-1961 period, District States produced 12.6 percent of the doctorates granted in the natural sciences, and California alone produced 9.8 percent of the total. Consistently, in every decade, the District’s share of new science doctorates has



outstripped its share of the nation's population. In 1960-1961, for example, the District accounted for 15.6 percent of new science doctorates, although it held only 13.6 percent of the nation's population in 1960.

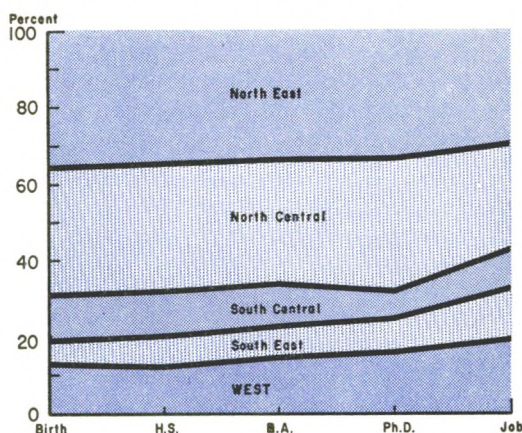
Understandably, the District leads in the production of doctorates in certain specific fields, in the same way that it leads the list of active scientists in those fields. California, for example, has accounted for 14 to 15 percent of the total national production of physicists and geo-scientists over the past four decades.

### Top schools, footloose scientists

The West's disproportionate share of doctorate production is related to the location within District States of five of the 22 "best" universities in the nation. Loud arguments rage within educational circles over the question of graduate school quality, but graduate school deans and faculty members generally tend to agree on the excellence of certain institutions, based on such criteria as the number of doctorates produced, the publication records of faculty members, and the intangible quality of prestige. The importance of these relative rankings—according to the compiler of one such list, the sociologist Bernard Berelson—is that "the higher the institutional level of the doctorate, the higher the subsequent post in academic life (and probably outside it, too)."

The West's ability to advertise five of the 22 "best" graduate schools in the nation thus accounts for its ability to attract large numbers of top-flight students and thereby to produce a disproportionately large share of the nation's new scientists. Just as important, the research strength of these and other Western universities has attracted the "foot-loose" research-oriented industries which have played such a dominant role in Western development—and these industries in turn have helped bring about a further influx of skilled manpower. In the words of a Defense Department

### Many recent Ph.D.'s migrate to West for education and jobs



Note: Chart shows regions in which recent (1957-61) Ph.D.'s were located at each stage of life cycle.  
Source: National Academy of Sciences—National Research Council.

analysis of research-and-development spending, "The process is circular, and it regenerates itself." Not only do production contracts follow research contracts, but the acquisition of production contracts in turn leads to the ability to strengthen research staffs.

The attractiveness of the West for foot-loose scientists is seen in a recent National Research Council study of the migration habits of Ph.D.'s. This study shows that about 13 percent of all new Ph.D.'s during the 1957-1961 period were born in the West but that 16 percent of the total received their doctorate in Western universities—and at least 19 percent of the total then obtained post-doctoral employment here. (The data refer to 13-state totals.) The West's attractiveness was even more striking in certain scientific fields; in physics, for example, 10 percent of the new doctorates were born in the West, but more than 23 percent of the group went to work here after their graduate training.

The West's drawing power for scientists, as for other workers, can of course be attributed to climatic and economic considerations. According to the much-cited climatic argument, migrants have been primarily attracted

by the mild climate, and the resultant heavy influx of population has stimulated employment expansion by attracting foot-loose industries and encouraging the growth of industry's local markets. This argument is probably just as much applicable to scientists—and to science-oriented industries—as it is to other fields. Similarly, relatively high pay rates also have acted as a magnet to scientists, as to workers in other fields; for male natural scientists, median earnings in 1959 were \$8,180 in California and \$7,750 in the nation as a whole.

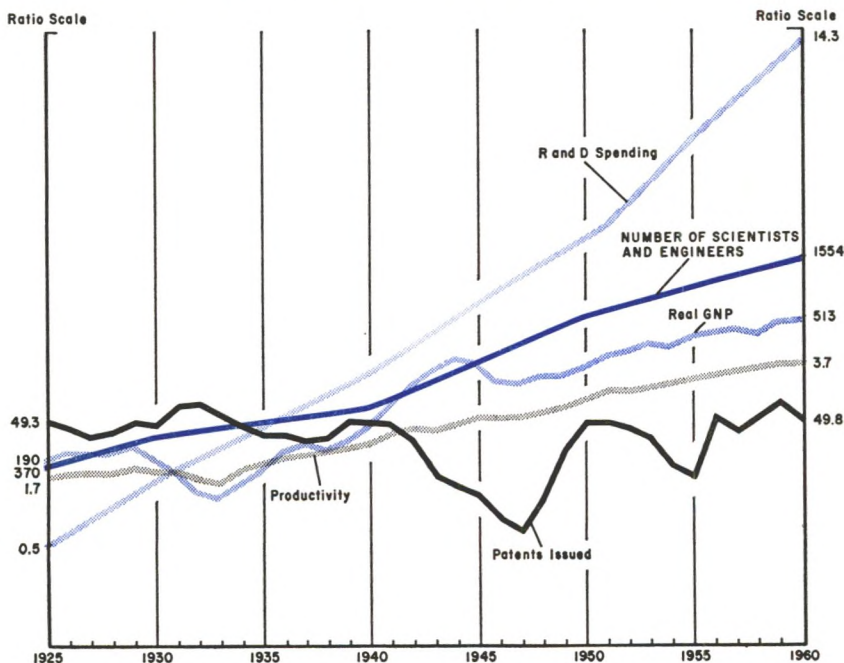
But the strength of the graduate schools—and the strength of the research centers and new industries that revolve in the orbits of the Western universities—is perhaps the strongest underlying cause of the West's continued leadership in scientific education and

science-oriented industry. This factor helps account, for example, for the West's leading role in the new aerospace industry; one-half of that industry's workers are employed in District States, and more than one-third of the total are concentrated in California.

### Crucial role of human capital

The stress which the West places on scientific education and scientific research highlights the influence of "human capital" investment on economic development. No estimates have been made of the quantitative effects of this factor on Western economic growth, but the evidence of this factor's substantial contribution to national growth suggests that it may be closely involved in the West's ability to maintain a higher growth rate than the nation as a whole.

### Real GNP and productivity rise at steady pace despite rapid expansion of scientific talent and R&D



Note: Real GNP and research-development spending shown in billions of 1962 dollars, productivity in real GNP per manhour, and number of scientists and number of patents in thousands.  
Sources: Department of Commerce, National Planning Association, National Industrial Conference Board, National Science Foundation, Federal Reserve Bank of San Francisco.

Human capital investment—that is, the contribution of education, on-the-job training, health, migration, and employment information—helps to explain the frequently observed discrepancy between the rate of growth of economic output and the much smaller rate of increase in the measurable inputs of labor, capital, and resources. By far the greatest contribution to growth has been made by increased education and by related advances in knowledge; these factors accounted for 43 percent of the



total growth rate of real national income in the 1929-1957 period, according to estimates published by Edward Denison in his *Sources of Growth in the United States*.

This twofold impact of education on growth—the *quantity* effect of increased amounts of education and the *quality* effect of increased knowledge—has been exerted through the efforts of the entire educational system, extending all the way from grammar school through graduate school. In coming decades, however, the stimulus arising from the increased quantity of education probably will decline (according to Denison's estimates), simply because the largest increases in the number of years of schooling have already occurred. This means that future increases in the educational contribution to the growth rate must come from advances in knowledge—which means in turn that university training in the sciences, and especially the application of scientific advances to the development of new industries, must play an increasingly important role in economic growth.

But will these applications actually take place? In particular, will there be a spill-over from the esoteric fields where the bulk of the scientific community is now concentrated? That question acquires some urgency since, according to critics of the manned space-flight program, that one field alone requires not only about 350,000 technical people, but—more important—a substantial share of the several hundred truly original scientific minds that the nation possesses.

Admittedly, new scientific advances have occurred in wholesale lots, but the proper harnessing of these inventions to the economy is by no means assured. In the space agency, for example, a "technology utilization program" has been set up to develop civilian applications of space-age scientific advances, but the Denver Research Institute recently analyzed this program and concluded that "relatively

little importance can be attached to the direct transfer of products from the missile-space program to the civilian economy." This criticism was made despite the space program's development of wonder metals, new fuel sources, and new light and power sources, not to mention the Telstar (communications) satellite and the Tiros-Nimbus (weather-forecasting) satellites.

### **Serendipity: slim pickings?**

This criticism leads to the somewhat heretical conclusion that the increased production of scientists and the rapid expansion of spending on scientific work may not lead to a proportionate expansion of the civilian economy, at least not without a substantial time lag. The number of scientists has increased roughly fourfold in the last four decades, and research-and-development spending (price-deflated) has risen at least 25-fold, but real GNP and output per manhour have increased just about 2½ times during that period—and one major measure of scientific activity, the number of new patents issued, has failed to increase at all.

One explanation, advanced by the economist Robert A. Solo in the pages of the *Harvard Business Review*, is that research and development have simply been misallocated in favor of aerospace and defense at the expense of growth-oriented civilian industries. Solo argues that economic growth depends upon the very limited number of creative industrial geniuses—men who are lost to activities which contribute to civilian technological growth if they are diverted (as they seem to be now) to aerospace research and development. Thus, their loss can only be offset by an intense spill-over of aerospace technological advances into the civilian sector.

Economic growth can arise, to some extent, through a direct application of the frequently astonishing products and processes developed in aerospace exploration. Growth must come

predominantly, however, through the difficult mechanism of harnessing the new discoveries so that they initiate revolutionary advances in business techniques and consumer markets. No one may be able to visualize what those advances will be—who, looking at the first internal-combustion engine, could visualize a freeway-centered civilization?—but many observers feel that continued growth depends on the scientific community’s ability to make spill-over a permanent reality.

Speaking at a Stanford University convocation in 1906, the philosopher William James

argued that “the wealth of a nation consists more than anything else in the number of superior men that it harbors.” The West—by emphasizing both the training of scientists and the application of their research to industrial progress—has demonstrated throughout the subsequent half-century how that wealth can best be mobilized. Nonetheless, today’s spill-over controversy shows that the West’s scientific community cannot automatically assume that a direct path lies between scientific promise and economic fulfillment.

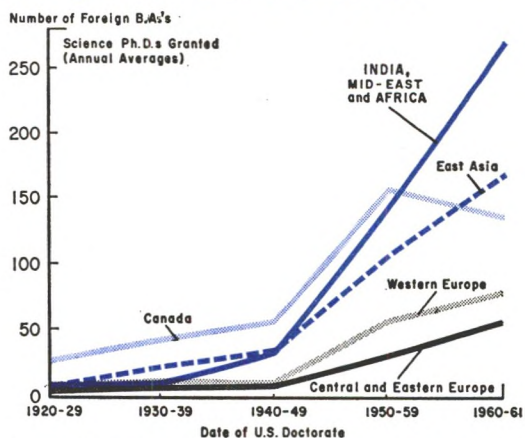
## The Foreign Contingent

**A**MERICAN universities have contributed to international as well as to domestic economic growth, by training large numbers of young foreign scientists who then disseminate their new-found knowledge throughout the world. In the 1920-61 period, 9,290 students with foreign undergraduate degrees received their Ph.D.’s in this country; about 26 percent were from Canada, 10 percent from Western and Northern Europe, 29 percent from India-Near East-Africa, and 21 percent from East Asia.

Students with foreign B.S. degrees have accounted for 11 percent of all Ph.D.’s in the natural sciences awarded in this country since 1920. (The proportion has been even higher—13.4 percent—at the West’s five leading graduate institutions.) The foreign contingent accounted for 8 percent of American doctorates in the 1920’s, dropped in importance in the 1930’s, and then increased rapidly: in 1960-61, this group received almost 16 percent of all science doctorates awarded in this country.

The recent inflow of foreign graduate students has come mainly from the Asian and African nations. These nations, which pro-

### Asia and Africa now provide bulk of foreign students at U. S. schools

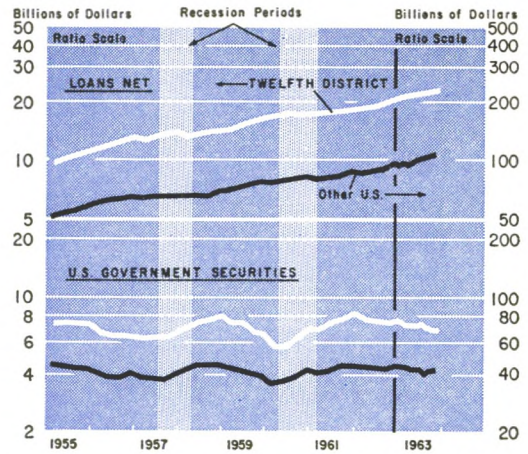
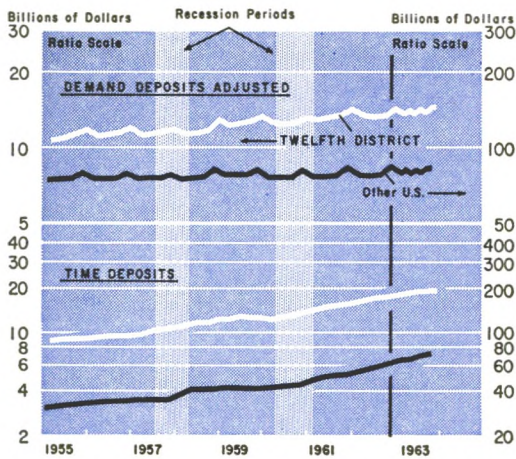


Source: National Academy of Sciences—National Research Council.

vided relatively few students four decades ago, in the 1960-61 period accounted for the vast bulk of the total. In the recent period, East Asia accounted for about 21 percent of the total and India-Near East-Africa accounted for 34 percent; Canada, on the other hand, saw its share drop from about one-half to less than one-fifth of the total between the 1920’s and today.

Twelfth District and Other U. S.

Condition Items of All Member Banks—



Source: Federal Reserve Bank of San Francisco. (End-of-quarter data shown through 1962, and end-of-month data thereafter; data not adjusted for seasonal variation.)

BANKING AND CREDIT STATISTICS AND BUSINESS INDEXES—TWELFTH DISTRICT<sup>1</sup>

(Indexes: 1957-1959 = 100. Dollar amounts in millions of dollars)

Year and Month	Condition items of all member banks <sup>2</sup> Seasonally Adjusted				Bank debits Index 31 cities <sup>5, 6</sup>	Bank rates on short-term business loans <sup>7, 8</sup>	Total nonagri- cultural employ- ment	Dep't. store sales (value) <sup>6</sup>	Industrial production (physical volume) <sup>6</sup>		
	Loans and discounts <sup>3</sup>	U.S. Gov't securities	Demand deposits adjusted <sup>4</sup>	Total time deposits					Lumber	Refined <sup>8</sup> Petroleum	Steel <sup>8</sup>
1951	7,751	6,370	9,512	6,713	57	3.66	80	68	99	87	97
1952	8,703	6,468	10,052	7,498	59	3.95	84	73	101	90	92
1953	9,090	6,577	10,129	7,978	69	4.14	86	74	102	95	105
1954	9,264	7,833	10,194	8,680	71	4.09	85	74	101	92	85
1955	10,827	7,162	11,408	9,130	80	4.10	90	82	107	96	102
1956	12,295	6,295	11,580	9,413	88	4.50	95	91	104	100	109
1957	12,345	6,468	11,351	10,572	94	4.97	98	93	93	103	114
1958	13,441	7,870	12,460	12,099	96	4.88	98	98	98	96	94
1959	15,908	6,495	12,811	12,465	109	5.36	104	109	109	101	92
1960	16,628	6,764	12,486	13,047	117	5.62	106	110	108	104	102
1961	17,839	8,002	13,676	15,146	125	5.46	108	115	95	108	111
1962	20,344	7,336	13,836	17,144	141	5.50	113	123	98	111	100
1963	22,915	6,651	14,179	18,942	157	...	117	129	102	112	117
1963											
January	20,609	7,333	13,725	17,407	146	...	116	127	104	113	98
February	20,837	7,344	13,831	17,585	148r	...	116	128	106	111	123
March	21,165	7,427	13,868	17,831	150r	5.46	116	130	107	110	123
April	21,246	7,097	14,063	17,850	149r	...	116	118	93	108	134
May	21,246	7,262	13,828	17,967	152	...	116	129	96	112	141
June	21,604	7,293	13,959	18,101	153r	5.53	116	127	97	116	129
July	21,761	7,059	14,044	18,290	158r	...	116	128	95	115	109p
August	21,890	6,958	13,990	18,334	162r	...	117	132	102	116	105p
September	22,236	6,968	14,102	18,409	166r	5.47	117	125	105	113	109p
October	22,387	6,698	14,106	18,727	167r	...	118	127	108r	112	104p
November	22,673	6,730	14,272	18,923	170r	...	118	130	106	110	114p
December	22,915	6,651	14,179	18,942	167r	5.47	118	136	111	110	112p
1964											
January	23,256	6,575	14,332	19,342	163	...	119p	135	...	111	116p
February	23,544	6,832	14,222	19,520	168	...	...	...	...	...	...

<sup>1</sup> Adjusted for seasonal variation, except where indicated. Except for banking and credit and department store statistics, all indexes are based upon data from outside sources, as follows: lumber, National Lumber Manufacturers' Association, West Coast Lumberman's Association, and Western Pine Association; petroleum, U.S. Bureau of Mines; steel, U.S. Department of Commerce and American Iron and Steel Institute; nonagricultural employment, U.S. Bureau of Labor Statistics and cooperating state agencies. <sup>2</sup> Figures as of last Wednesday in year or month. <sup>3</sup> Total loans, less valuation reserves, and adjusted to exclude interbank loans. <sup>4</sup> Total demand deposits less U.S. Government deposits and interbank deposits, and less cash items in process of collections. <sup>5</sup> Debits to demand deposits of individuals, partnerships, and corporations and states and political subdivisions. Debits to total deposits except interbank prior 1942. <sup>6</sup> Daily average. <sup>7</sup> Average rates on loans made in five major cities, weighted by loan size category. <sup>8</sup> Not adjusted for seasonal variation. p—Preliminary. r—Revised.

