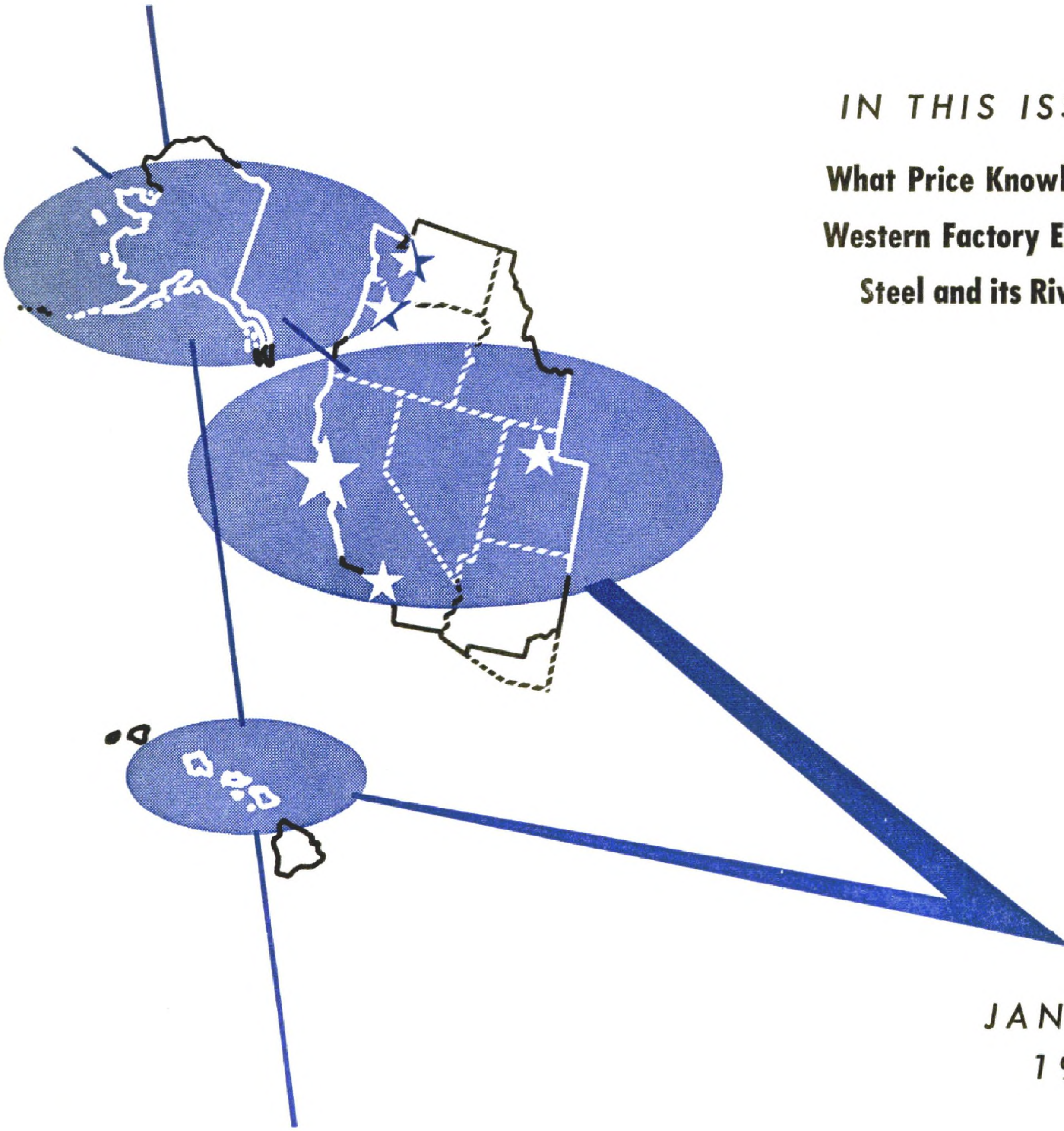
FEDERAL RESERVE BANK OF SAN FRANCISCO

MONTHLY REVIEW



IN THIS ISSUE

What Price Knowledge?

Western Factory Exports

Steel and its Rivals

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What Price Knowledge?

. . . The West, with its emphasis on education and scientific research, accounts for one-fourth of this crucial growth-creating sector.

Western Factory Exports

. . . District manufacturers sell $2 billion of their products in overseas markets—especially aircraft, lumber, food, and metals.

Steel and its Rivals

. . . Despite its strong recent performance, the steel industry faces stiff competition from imported steel and domestic substitutes.

Editor: William Burke

What Price Knowledge?

WHENEVER economists gather together these days, they not only exchange knowledge; they also talk *about* knowledge. (Witness the program at the recent American Economic Association convention, which was devoted almost entirely to discussions of that particular subject.) This intense interest is due in large part to the rapid growth of the knowledge-investment sector of the economy, that is, the nation's investment in education and research-and-development.

The importance of knowledge was recognized as long ago as 1776. Adam Smith at that time argued that "Man educated at the expense of much labor and time may be compared to an expensive machine." And Benjamin Franklin, Smith's contemporary, declared that "An investment in knowledge pays the best interest." But only recently has the interest of economists been centered on the subject of economic growth and on the types of investment—such as investment in the production of knowledge—that will pay off in the future through growth-stimulating increases in productivity. A prime example is the work of Princeton Professor Fritz Machlup, *The Production and Distribution of Knowledge in the United States.*

Crucial categories

According to Machlup's all-encompassing definition, the knowledge industry includes education, research and development, communications media, information machines, and information services. But the crucial categories are education and R & D—the knowledge-investment categories — which in 1965 expended roughly $120 billion in the nation and an astonishing $30 billion in the West alone.

Education, the largest knowledge sector, amounted to roughly $100 billion in the nation and $20 billion in the West last year. The total includes the cost of all types of education —elementary, secondary, and higher education, plus the knowledge acquired at home, on the job, or in the armed services. More than that, it includes the earnings foregone by those who are absorbing knowledge rather than contributing to the community's physical or knowledge output.

Research and development (R & D) probably contributed over $20 billion to gross national product last year—and roughly $10 billion, or almost one-half of that total, was produced in Twelfth District states.

Education + R & D = investment

Education is designed to produce existing knowledge in new minds and to make these minds more receptive and more capable of absorbing, transforming, creating, and using knowledge. R & D, meanwhile, is designed to produce new knowledge. Neither education nor R & D creates tangible assets on a balance sheet. But both make a contribution to future returns, that is, to the increased productivity of resources.

This crucial segment of the knowledge industry sustains a two-way link between successful investment, which permits the faster growth of GNP, and GNP growth, which permits more investment in knowledge production. In underdeveloped countries, the inability to sustain this link creates a vicious circle of poverty; in developed countries, the successful operation of this mechanism creates a beneficent spiral. Increases in education and technology promote rising incomes, and these higher incomes afford rising expenditures for education and R & D.

Chicago Professor Theodore Schultz points out that "The growth of this investment in human capital may well be the most distinctive feature of the economic system. Increases in national output have been large, compared

Higher Education—1965

The Higher Education Act of 1965, signed into law last November at Southwest Texas State College, more than doubles the $410-million annual authorization for colleges and universities established under the Higher Education Act of 1963. The new law lowers to 3 percent the interest rate on Federal loans for undergraduate school construction (about a full percentage point below the current rate) and it also increases the types of facilities for which Federal construction aid may be obtained. The act, moreover, for the first time provides for:

1. Scholarships averaging $500 a year each for needy students, particularly those whose parents earn $3,000 a year or less. The aim is to ensure that as many as 140,000 poor but talented youths each year are afforded a college education.

2. A low-interest loan program, eventually to total $700 million a year or more, for middle-income students. The loan funds would be provided partly by the Government and partly by private lending institutions, and a significant portion of the interest payment would be underwritten by the Government if a student's parents earn less than $15-18,000 a year.

3. A far-ranging "university extension" program to propel colleges and universities into a variety of community services. These include research on urban problems —such as air and water pollution, juvenile delinquency, and consumer education— and the training of urban experts and other professionals.

4. A grant program to raise academic standards of small, poorly financed colleges, particularly 106 predominantly Negro schools in the South. Federal assistance would help those schools attract and hold competent faculties; in addition, it would help them establish formal ties with wealthier institutions, in such forms as faculty and student exchanges, joint use of facilities, and postgraduate teacher training.

5. A postgraduate fellowship program to help up to 10,000 elementary- and secondary-school teachers a year obtain masters degrees. This program would extend already existing programs which help defray the costs of Ph.D. training.

6. A "teachers corps," composed eventually of 6,000 volunteers (novices and veterans alike), to teach in poverty-stricken areas where educational problems are severe and school resources scant. Corps members, after a three-month university training period, would be assigned as requested by local school districts, but would be paid completely out of Federal funds.

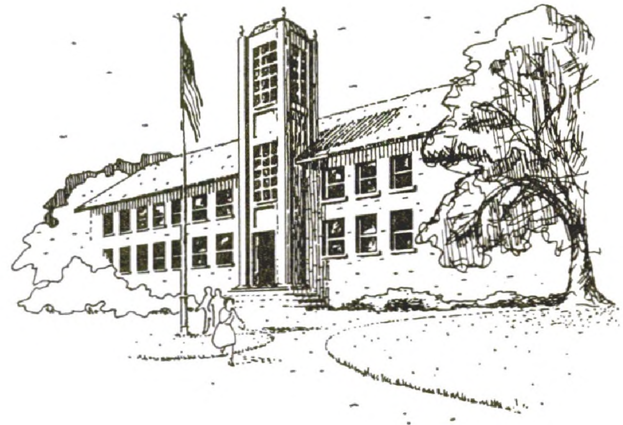
with increases in land, manhours, and physical reproducible capital. The investment in human capital is probably the major explanation for this difference."

According to the widely cited estimate of Brookings Institution's Edward Denison, knowledge investment accounted for about 40 percent of the 2.9-percent annual rate of growth in the 1929-1957 period. Denison estimates that the rising education of the labor force was responsible for 23 percent of the growth in real national income in that period, and that the general advance in knowledge, typified by R & D and improved management techniques, was responsible for another 20 percent of the growth rate. He estimates also that knowledge investment will account for a comparable proportion of the increase in growth between now and 1980.

What education costs

Nonetheless, knowledge investment can be a costly affair, as the West's educational statistics amply demonstrate. In the public-education sector alone, California increased its spending for lower schools from about $1½ billion to about $2½ billion between 1958 and 1965, and undoubtedly will substantially exceed the $3 billion mark by 1970. District states as a whole increased their spending in this category from about $2 billion to almost $4 billion in the 1958-1965 period, and may well approach the $5 billion level by 1970.

Expansion of higher-education costs has been even more startling. For public institutions alone, these costs more than doubled in the 1958-1965 period, to roughly $1 billion in California and $1½ billion in all District states. Moreover, according to the Council of State Governments, higher-education costs will soar by 1970 to around $2½ billion in California and almost $3½ billion in the District as a whole. Yet, in view of the region's long educational tradition, it may be quite willing to sustain costs of this magnitude.



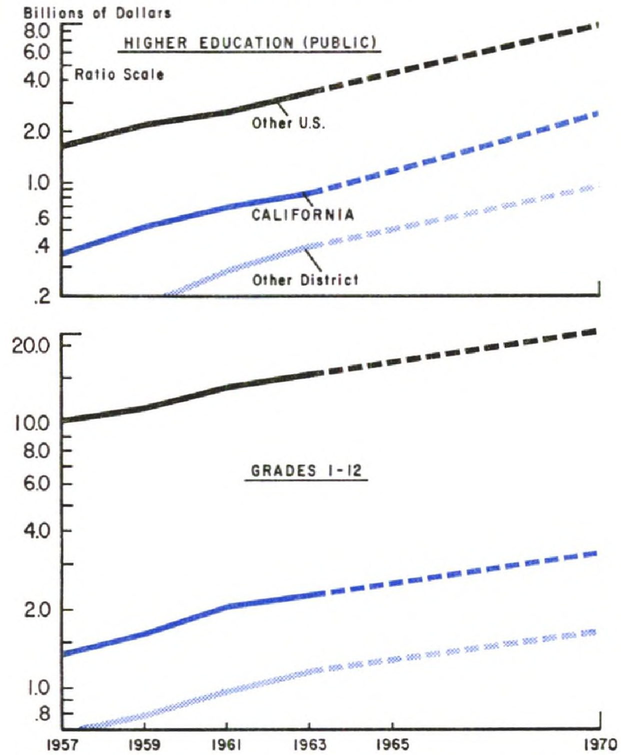
Why it costs

The necessity for increased educational investment is due in large part to the simple pressure of numbers. These pressures are most obvious in the nation's most populous state, California. Primary and secondary public-school enrollment in California increased from 2.9 million to 4.1 million between 1958 and 1965, and state officials anticipate further growth to 4.8 million in 1970 and 5.9 million in 1980. Moreover, California's enrollment of full-time college students increased by two-thirds, to 400,000, in the 1960-65 period alone. Already, 53 percent of California's high-school seniors enter college. (The ratio is much higher in some areas; for example, 62 percent in San Diego.) And, as the lower-school enrollment figures indicate, there is a rising flood of students behind the present college generation.

The same pressure of numbers is seen at the national level. Federal officials expect that degree students at public colleges and universities will increase from 4.5 million to 7.7 million in the 1963-1970 period and will then rise to 9.5 million by 1975.

But far more than numbers is involved in the rising demand for higher education. With increases in family income, a larger proportion of the population is able to afford the costs associated with sending children to college and foregoing their earnings while there.

Education costs continue rapid rise, especially at college level



Source: Bureau of the Census; Council of State Governments

With the migration of the population to urban industrial areas, a larger proportion of the population resides in communities where facilities are available and where higher education is demanded as a job passport. And, with rapid advances in technology, a phenomenal increase in demand has occurred for graduates possessing the necessary skills.

Why it's worth it

The average high-school student and his parents now understand, fully as well as does the average economist, the importance of increased investment in knowledge. Whether or not they have seen the figure of $100,000 as the value of a college education—that is, the difference in lifetime earnings between the man with a degree and the man without one—they are well aware that inequality in the distribution of income is positively related to inquality in educational background, and that unemployment hits most severely those who have the weakest educational backgrounds. By now, an impressive body of evidence supports the thesis that educated and skilled persons almost always earn more than others—a thesis which is true for different types of developed countries (such as the U. S. and the U. S. S. R.), for different types of underdeveloped countries (such as India and Cuba), and for completely different time periods (such as the U. S. a century ago as compared with today).

A number of attempts have been made to calculate the rate of return on investment in education. According to one such estimate, made by Columbia Professor Gary Becker, the average college entrant obtains a 10-12 percent annual return on his investment—and the urban-white-male college graduate obtains an even higher return. Other specialists would estimate the rate of return differently—some higher, some lower—but few would dispute the fact that those who receive the most education are going to move into virtually all the key jobs. In the words of HEW Secretary John Gardner: "The question, Who should go to college?, translates itself into the more compelling question, Who is going to manage the society?"

The crucial link

The university, or multiversity, has in any event become the center of the knowledge industry. A heavy demand exists for certain kinds of knowledge and for knowledgeable people to move the nation toward the social and technological goals it sets for itself, and the modern university has come forward to meet those demands. It has done this especially by welding a closer association with the other crucial element of the knowledge industry—research and development.

The interlocking of the two types of knowledge investment was emphasized in a widely quoted report, "The Changing Patterns of Defense Procurement," issued by the Defense

Department in mid-1962. "Management planners, in considering sites for new or expanded facilities, have found the availability of trained minds overshadows even such factors as the labor market, water supply, and power sources. The evidence is overwhelming: Route 128 encircling Boston, the industrial complex around San Francisco Bay, that related to the institutions in the Los Angeles area, and similar situations are cogent examples of the clustering of industry around centers of learning." And 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 process is circular; and it regenerates itself."

R & D is the only sector of the industry which deals with knowledge production in the narrow sense, that is, production of socially new knowledge. This sector consists of several activities: basic research, applied research, and development. Basic research looks for general laws with no regard for practical use; applied research looks for results promising some ultimate use. (The former searches for discoveries and the latter for inventions.) Development, on the other hand, is technological activity using scientific knowledge already developed for the production of useful materials, systems, or processes.

What R & D costs

The growth of R & D has been phenomenal, as every reader of the stock-market page can testify. R & D spending increased from about $1/3 billion in 1940 to $14 billion in 1960—a 20-percent annual rate of growth—and it probably exceeds $20 billion today. The Federal Government's role in financing R & D is conspicuous, but private industry predominates in the performance of this activity, and in recent years it has also increased its spending for this purpose. Today, stock-market analysts use a corporation's R & D budget as an index of its future profit performance, and consumers seem more impressed by a firm's reports on its research activities than they are by the TV programs it sponsors.

The R & D sector's record of rapid growth was affected recently, however, when spending restraints were imposed by the industry's dominant paymaster, the Federal Government. Federal R & D expenditures, after rising steeply to $11.3 billion in fiscal 1963 and $13.8 billion in 1964, then leveled off in 1965 near the 1964 level. This setback was caused primarily by a slowdown in the hitherto rapidly expanding space program, and by the completion of the planned buildup in strategic-missile production.

California and the other District states, which had been prime beneficiaries of the earlier R & D boom, felt the full impact of the recent shift in Federal policy. Even in heavy-spending 1964 (the last year for which detailed data are available), R & D spending in District states increased less than half as much as in the rest of the country, and California showed an increase only because a heavy inflow of space-research funds offset a reduction in DOD spending.

This shift in Federal R & D spending policy, along with the related cutback in defense procurement, led to a sharp (albeit temporary) reduction in regional aerospace employment, and persuaded California state agencies to encourage the rechanneling of R & D efforts into such diverse fields as transportation, waste disposal, crime detection, and information retrieval.

Why it's worth it

Despite such occasional setbacks, R & D investment remains very attractive, in large part because of the enormously lucrative returns which are frequently obtainable from R & D projects. The measurement of rate of return is complicated, however, by the likelihood that the social return will be higher than the private benefit from each such investment. The investor and the initial user will certainly benefit from the economically successful development of an R & D project, but total benefits are likely to be much greater. If the project permits reduced prices, consumers will benefit, and if it permits the spread of new technology, competitors also will benefit.

A crucial element in R & D investment today is the computer-based information revolution. Spending for computers has expanded rapidly, doubling in the 1959-63 period after an eight-fold increase in the preceding four-year period. The computer revolution has affected every aspect of the economy, primarily by providing decision-makers with completely new perspectives on their operations. Business management, which formerly dealt with an organization of bits and pieces (engineering, production, inventory, accounting, marketing, etc.), with the help of the computer is now enabled to see the organization in terms of a continuous flow of information which ties all individual operations together.

All of the above simply measures the extent of the nation's $120-billion knowledge investment. But describing this crucial sector does not indicate which regions should receive new funds for knowledge investment, which fields should be emphasized in new educational and R & D spending, and especially, what the eventual consequences of all this will be. Around each of these issues a great deal of controversy now rages.

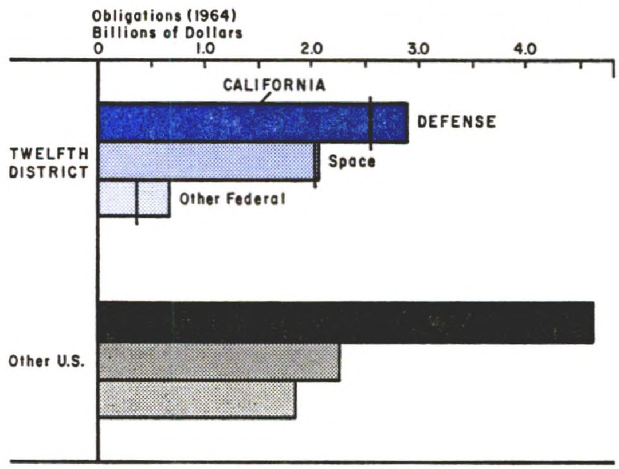
Geography: where allocated?

Consider the geographical allocation of R & D spending. For example, Federal R & D allocations (which differ somewhat from the expenditure data cited earlier), reached $12.3 billion in 1963 and $14.3 billion in 1964, and in each of those years the West received more than the next three geographical areas combined. California alone received 35 percent of these Federal funds, or four times as much as New York, the second state in line. Thus, despite the recent slowdown in the inflow of R & D funds, the West retains a dominant position in this crucial growth-generating sector.

A similar concentration occurs in the allocation of funds on an agency basis. The Department of Defense, the National Aeronautics and Space Administration, and the Atomic Energy Commission spent 90 percent of all Federal R & D funds in recent years, and each of those agencies allocated the largest single block of its funds to District states. In 1963, for example, the six largest DOD contracts went to Western firms, five of the first six NASA contracts found their way to the West, and six of the fifteen largest AEC contracts were spent here.

On a university basis, Federal expenditures are heavily focused on a relatively few universities which are concentrated in three major geographical areas. (Twenty universities—only one-tenth of all universities in the country—have received four-fifths of all such funds in recent years.) These high plateaus of academic excellence are the Western range extending from Berkeley and Stanford to Pasadena and Los Angeles, the Eastern range

Western dominance in R&D
based on strong aerospace research



Source: National Science Foundation

extending from Boston to Washington, and the Midwestern concentration centered around the Big Ten and Chicago. At the university and research laboratories situated in the California concentration are found 36 percent of the Nobel Prize winners in science, and in the Eastern and Midwestern concentrations are found 46 percent and 10 percent, respectively, of the Nobel science laureates. And as a group these universities produce three-fourths of the nation's Ph.D.'s

The concentration of Federal R & D spending in these centers has strengthened the handful of front-rank institutions and thus has widened the gap between them and all other research institutions. Moreover, since the Federal Government is the major supporter of university-based science, and since scientists (through the project system and other advisory procedures) determine which institutions will obtain new project funds, the front-rank institutions have been able to attract more and more research-oriented industry and thereby have generated a faster pace of economic growth in the regions in which they are located.

Some dispensers of Federal funds see no alternative to this procedure. One agency spokesman told a Congressional investigating committee: "DOD would probably like to see a more uniform distribution, but we have to go where the talent is, and we have to get the best weapons system we can get." Another agency spokesman added: "NASA cannot, nor can any other agency of the Government, place research projects at universities which do not have the resources to make a valued contribution to the agency's mission." But some Congressmen argue that science is too important a matter to be left to the scientists.

High-energy politics

The question came to a head in a still-continuing controversy over the construction of a $300-million high-energy nuclear accelerator—the world's most powerful "atom smasher." Nuclear accelerators, the basic tools of high-energy physics, are employed to probe the structure of the infinitesimally small particles that make up the nucleus of the atom. They utilize energies in the multibillion-electron-volt range to hurl subatomic particles into collision with other particles; the greater the energy, the deeper the physicist can probe into the heart of the atom.

In the competition for the construction of this mammoth machine, a scientific advisory committee to the Atomic Energy Commission decided on a California design and thereby rejected a Midwest-designed accelerator. Most scientists agreed with the decision, but the controversy raised a political storm that was felt at the very highest level. Even now, the site of the proposed machine remains undecided. Proposals were initially received from 126 communities located in 46 of the 50 states; 85 of those communities still remain in contention for the AEC's award, and all of them feel uniquely qualified to provide a home for a 200 billion-electron-volt nuclear accelerator.

The eventual consequence may be a shift from a situation of "intuitive imbalance" to one of "bureaucratic balance," through a deliberate Federal effort to develop a much larger number of outstanding research centers. The National Education Improvement Act of 1963 signalled this shift by providing for the expansion of outstanding research centers from 20 to 70, and President Johnson in a recent directive emphasized the new direction by stating that research funds "are still too concentrated in too few institutions in too few areas."

But some authorities worry that a shift of such magnitude would draw too heavily upon the very small pool of top-flight scientists and thus hamper research efforts at the leading institutions. Former Presidential adviser George Kistiakowsky, speaking for the National Academy of Sciences, supports this view but also suggests a possible compromise: "The 10,000 research grants now given by the Federal government are chosen on the basis of excellence plus past record of achievement; these should continue in the same way . . . Quite a separate program should be instituted for other institutions—after the selection of these possible new centers of excellence, they can be given temporary grants for a quantum jump to the next level of excellence."

R&D

In modern industry, research,
Has come to be a kind of church,
Where rubber-aproned acolytes
Perform their Scientific Rites,
And firms spend funds they do not hafter,
In hopes of benefits Hereafter.

—Kenneth Boulding

Brains: where allocated?

A somewhat related argument centers around the charge that too many of the nation's top brains are allocated to the wrong tasks, no matter what region they work in. Critics of the present concentration of top-flight talent in aerospace programs contend, for example, that much of this talent could be better utilized in the civilian economy—the nation's basic growth-creating mechanism. As examples of misallocation of resources, these critics point to the large number of weapons systems developed at great cost but never produced, the large number of firms competing for development and production contracts in such esoteric fields as orbital-guidance equipment, the use of scientific manpower in administrative and subprofessional duties (such as the preparation and marketing of project proposals), and the stockpiling of skilled manpower as a hedge against future contract activity.

Professor Machlup, in discussing the best uses of knowledge investment, points out that scientific manpower has three alternative uses—education, basic research, and applied research. The cost of using scientists to produce new technology consists of the loss of either new trained minds (education) or new scientific knowledge (basic research). Despite the obviously high rate of return on R & D, it would be wrong to allocate resources predominantly to applied work, since the concentration on R & D in the here and now could be achieved only by sacrificing future R & D. But this opposition of alternative uses does not occur in the case of basic research, where the performer is at the same time a teacher. "The would-be scientist must learn what it is like to do science, and this, which is research, is the most important thing he can be taught."

Future: certain or uncertain?

Needless to say, more and more revolutionary changes lie ahead as a consequence of continuing investments in knowledge. A glimpse at the shape of this future may be afforded by a recent Rand Corporation survey, in which 82 experts from a number of fields suggested developments that they considered likely to occur by the end of this century.

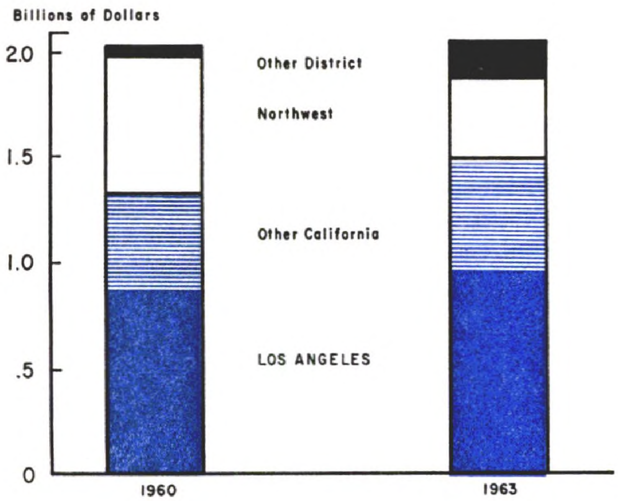
The experts foresee the development of thermonuclear power, the mining of the ocean floor, the production of synthetic protein for food, the establishment of a permanent moon base as well as stations on Mars and the other planets—and the conquering of the common cold. They foresee the displacement of one-fourth of the present workforce within a decade through the automation of office work and teaching, and they also predict the development of a computer-based world language, of completely automatic highways and skyways, and of automated tax (and garbage) collection. In the field of warfare, they foresee the development of bio-psychological weapons that would harm neither life nor property but would destroy the will to resist. (New Yorkers, with their water-power-subway problems, may be forgiven for visualizing themselves as the initial victims.)

Yet, despite the forthright nature of these predictions, the most certain thing about knowledge investment is its very uncertainty. Investment resulting in significant scientific advances is universally uncertain, with occasionally happy and frequently unhappy surprises being its normal consequences. And, in addition to technological uncertainty, knowledge investment shares with other types of investment the condition of environmental uncertainty—uncertainty about the kinds of new products that will be useful or saleable in the unknown environment of the future period in which they become available.

What response can be made to knowledge investment in this era of uncertainty? The anthropologist Margaret Mead argues that every user of the new technology has mixed attitudes—"each is a potential supporter and advocate sufficiently entranced by the possibilities of new devices to use them and dream of a form of life which will be permeated with the new technology and which will yet be human and desirable—yet each is a potential rejector, bemused, frustrated, and left behind." To deal with this situation, French historian Raymond Aron agrees that undoubtedly everyone should understand science better and everyone should receive a better education—but "the supreme virtue of the mind in a scientific society and in a revolutionary era is . . . flexibility, imagination, the capacity of not being a prisoner of stereotypes, of remaining open to new developments." For the individual, for the nation, and for every region of the nation, there is probably no better response.

—*William Burke*

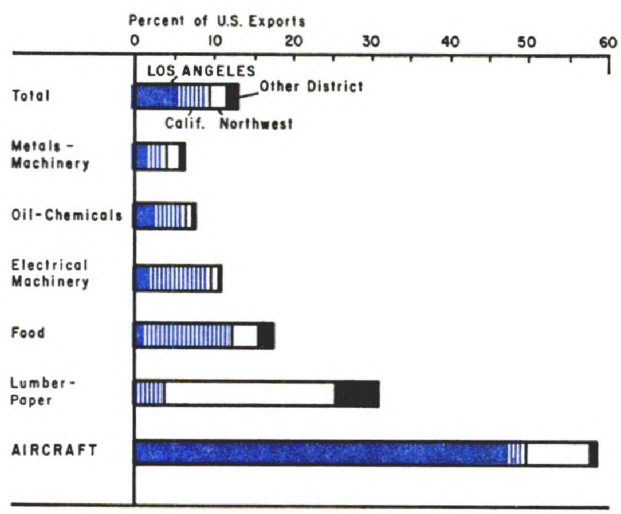
West's Factory Exports Reach $2 Billion



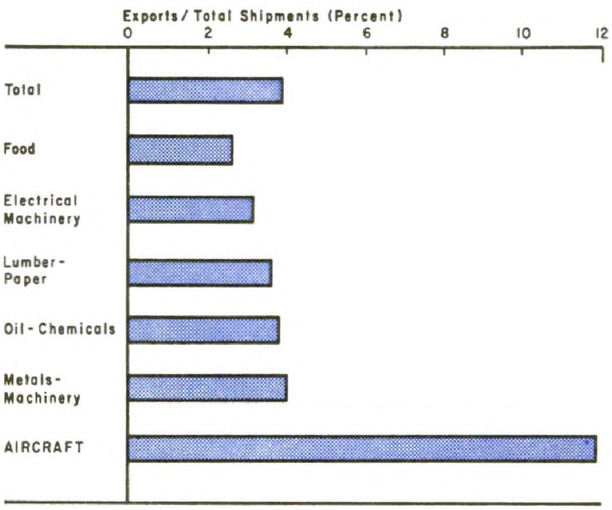
Twelfth District states exported $2.06 billion of their manufactured products in 1963, and thereby accounted for 12.6 percent of the nation's total factory exports in that census year. . . . Los Angeles by itself accounted for about 6 percent of the nation's total overseas sales. Other California areas accounted for 3.2 percent of the national total, and the comparable figures for the Pacific Northwest and the other District states were 2.4 and 1.0 percent, respectively. . . . California and the Mountain states recorded substantial gains in export sales between 1960 and 1963. (California led all other states in sales in both of those years.) Northwest exports declined because of a drop in aircraft sales.

West Dominates Several Export Fields

Western producers accounted for over 58 percent ($597 million) of the nation's total aircraft exports in 1963, despite Washington's export decline that year. Los Angeles producers alone accounted for almost half of U. S. aircraft export sales. . . . District states—primarily the Northwest states—also dominated the lumber-and-paper export field, with 31 percent ($200 million) of the national total. . . . Western manufacturers in 1963 exported $291 million in food products and $300 million in metals and machinery. Their share of the nation's total overseas sales in those two sectors amounted to 17 and 6 percent, respectively.



Factories Ship 4 Percent Overseas

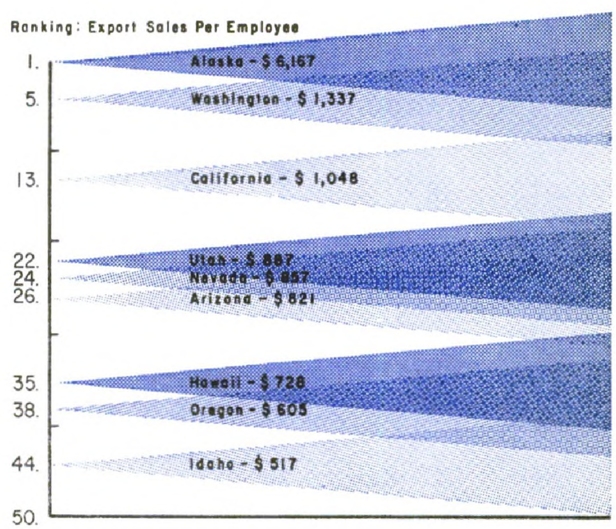


The West, like the rest of the nation, exported roughly 4 percent of its factory output in the 1963 census year. . . . The aircraft industry dominated the export scene, in relative as well as dollar terms. Its $597 million in overseas sales amounted to about 12 percent of its total shipments—considerably better than the export performance of the aircraft industry nationwide. . . . The Western lumber-and-paper industry, with about 3½ percent of its products going overseas, also bettered the export performance of its industry competitors. But most other District manufacturers shipped a smaller proportion of their output overseas than did their competitors nationwide.

High Ranking in Sales per Worker

Alaska led the rest of the nation in terms of export sales per factory worker in the 1963 census year. Alaska's $6,167 figure far exceeded the national average of $954 per employee, since its exports were concentrated in the highly efficient paper industry. . . . Washington and California also exceeded the national average in this regard. But California, which led the nation in total export sales, lagged behind several other major industrial states (Illinois, Michigan, Ohio) in terms of export sales per worker. . . . Utah, Nevada, and Arizona, with relatively high exports per employee, ranked near the middle of the national distribution.

—Paul Ma



Steel and its Rivals

THE NATION'S steelmakers poured 130 million tons of steel in 1965, and so, for the second straight year, they exceeded the previous peak of 117 million tons recorded in 1955. The industry's performance in the intervening decade was somewhat sluggish, however, as production year after year held below the 100-million-ton level. Two recessions and a major steel strike helped account for this uninspired performance, but the industry's declining competitive position was also a contributing factor.

The industry's critics during steel's sluggish decade suggested that the industry had become too complacent about its previous run of successes. Steelmakers, after all, had run up a string of new production records throughout most of the 1940-1955 period. During World War II, they consistently were forced to allocate tonnage. During the first postwar decade, they continued to strain capacity, first to meet pent-up demands for reconversion, then to fulfill Korean War requirements, and then again to meet the demands of the producer-durables boom of the mid-1950's. Despite substantial success, however, frequent shortages of supply and constantly rising prices occurred, so that steel users turned increasingly to imported steel and substitute materials. These shifts, plus a slowdown in durable goods production, helped to bring about the industry's more recent problems.

Western gains

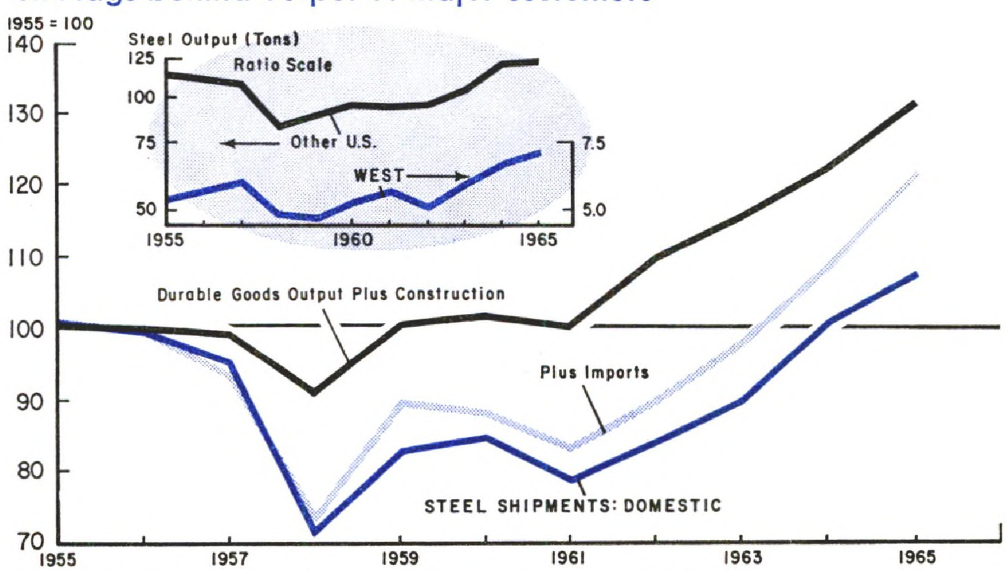
The Western industry, like the national industry, has only recently returned to the peak levels of a decade ago. Its performance, nonetheless, has consistently exceeded that of the national industry. District mills expanded ingot production by one-third, from 5.0 to 6.8 million tons, in the 1955-1965 period—and, in the process, increased their share of national output from 4 to 5 percent.

The Western industry's growth differential has reflected the vigorous growth in Western demand for steel and for everything else besides. The differential has also reflected the success of District producers in maintaining a dominant position, vis-a-vis other domestic producers, in the regional market. Over the decade Western producers have supplied about 60 percent of regional receipts of domestically produced steel-mill products.

Customers and challenges

In any event, the recent strength of the national and regional industries cannot disguise the threat posed by foreign steel pro-

Steel output exceeds former peak, but production still lags behind output of major customers



Source: U. S. Department of Commerce; American Iron and Steel Institute ducers and by domestic producers of substitute materials. The industry's strong 1964-1965 performance may testify perhaps more to the recovery of the steel industry's major customers than to its ability to stave off the strong competitive challenges of foreign steel and domestic substitutes.

This point was at issue in the controversy over the industry analysis conducted last year by the Council of Economic Advisers. The Council argued: "The long-term decline in the industry's operating rate reflects steel's loss of markets to other materials—mainly aluminum, plastics, cement, and glass—and to foreign steel producers. The doubling of steel prices in the 1950's played an important role in these losses." But a leading critic of the Council's report, New York University's Professor Jules Backman, replied: "The role of competitive products has been considerably exaggerated by the CEA in its explanation of the loss in steel markets. The lag in steel production and consumption reflected primarily the lag in demand for capital goods and for consumer durable goods. As the rate of growth for capital goods and consumer durable goods once more has increased, the demand for steel also has expanded strongly."

The question is still open, although recent data suggest that both the Council and its critics may be correct. The industry's production has recovered strongly in tandem with the ebullient performance of the major steel-consuming industries. At the same time, the industry's competitors have, if anything, continued to increase their market penetration.

Derived demand?

During the industry's sluggish decade, it became abundantly clear that steel demand is a derived demand. Production tended to lag during that period as a consequence of the relatively sluggish performance on the part of such industries as heavy construction, autos, appliances, containers, and machinery.

Even so, shipments of finished steel-mill products declined in relation to activity in consuming industries. Construction and durable goods industries regained their 1955 level of activity by 1961, and then grew by 31 percent in the 1961-1965 period. But steel shipments declined 22 percent between 1955 and 1961, before advancing to a point about 7 percent above the decade-ago level in 1965. By 1965, then, steel shipments would have been about 20 million tons above the level actually attained if consuming industries had increased their steel purchases as much as they did their own output.

Admittedly, the steel industry's own technological progress has been a major factor in reducing tonnage demand. The declining ratio of shipments to durable goods production reflects the development of stronger yet lighter gauges of steel, so that each ton of steel now yields far more finished products than heretofore. For one example, a ton of new thin tinplate produces 40 percent more citrus-juice cans than does a ton of ordinary electrolytic plate. For another example, a ton of improved line pipe is now capable of transmitting 60 percent more gas than a ton of the standard pipe material of a decade ago. Since steel prices in general have risen very little over the last five years, reduced tonnage resulting from the development of lighter gauges of steel has served to hold down revenues.

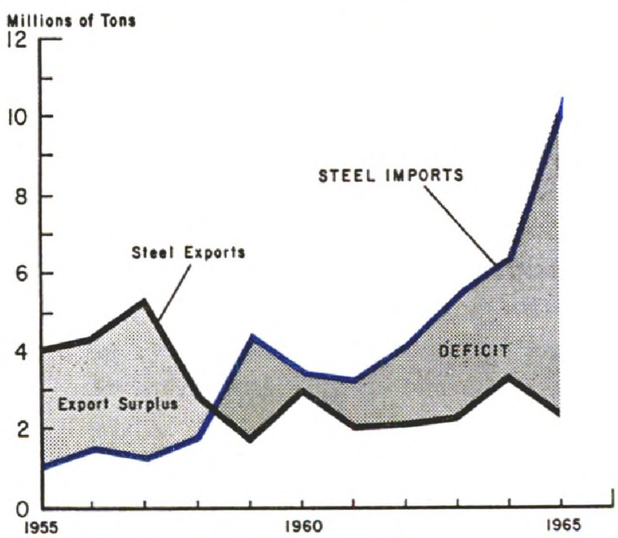
To cure this problem, the industry has begun programs designed to bring about substantial cost savings. In the 1964-65 period it spent about $1.8 billion annually in modernizing and expanding its facilities—over one-third more than its average annual spending for such purposes in the 1955-63 period. Revolutionary production processes have been introduced, including the concentration and beneficiation of lower-grade ores, the introduction of continuous casting, and the conversion to oxygen converters. About one-eighth of the industry's output is now produced in oxygen converters (and the proportion is expected to approach one-half by 1970), whereas hardly any was produced by this efficient process a decade ago.

Challenge: foreign

But foreign producers, like American producers, have also made rapid technological strides, and the result has been a vast increase in the availability of attractively priced foreign steel in the American market. Between 1955 and 1964, steel imports rose from less than 1 to more than 6 million tons, and then jumped to over 10 million tons in 1965. Since steel exports trended down from 4 to 2½ million tons over the entire period, almost 11 million tons of steel shifted from American to foreign orderbooks.

Imported steel represented only about one percent of the domestic market in 1955, but it began a significant market penetration during the 116-day steel strike of 1959, gaining over 6 percent of the domestic market in that year. By 1964 the import share increased even more, to over 7 percent, and it then jumped to 10 percent in 1965, on the heels of a substantial strike-anticipation inventory buildup.

Foreign invasion of American market creates substantial export deficit



Source: American Iron and Steel Institute

This development has been most striking in the West, where imports increased their penetration to 18 percent in 1964 and apparently gained an even stronger market share in the following year. In some sectors, imports have now gained a dominant position, accounting for as much as 40 percent of the District market for pipe and 25 percent of the regional market for sheet and strip steel.

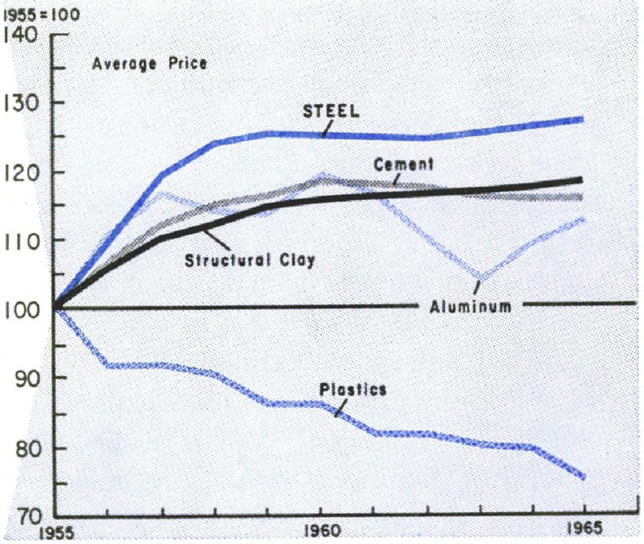
This penetration of imports has continued in the face of a 1962 action designed to help the Western industry combat steel imports. In earlier years, Western producers could charge a higher base price than other domestic producers because of the high freight charges on steel shipped in from the East, but in doing so they made the West an uncommonly attractive market for foreign producers. Consequently, in late 1962, regional mills reduced their base price an average of $12 a ton in order to improve their competitve situation vis-a-vis imports. Nonetheless, the import flood continued and, if anything, gathered more strength in subsequent years.

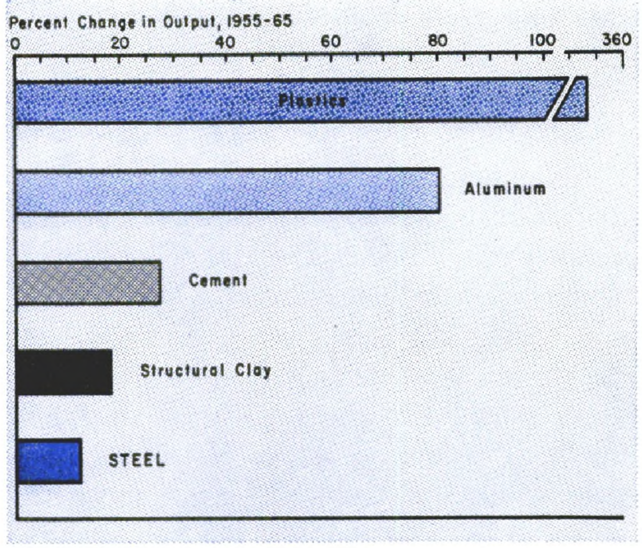
Price increases announced by regional and other mills early in January certainly will not help the industry's import problems. Domestic producers increased structural-steel prices by $2.75 a ton at that time, even though imported structurals already were selling $10-25 a ton below American prices.

Challenge: domestic

But foreign competition remains only one of the industry's competitive problems. Even when imported steel is included, total steel shipments nationwide have lagged behind the rise in output of steel-consuming industries. Between 1955 and 1965, total shipments (domestic plus imports) increased 21 percent, but output in construction and durable goods industries increased 31 percent in the same period. This difference is attributable in large part to the market penetration of substitute materials.

Market penetration by steel's major competitors helped along by their more successful price performance





Source: U. S. Department of Labor; Federal Reserve Board

Over the past decade, shipments of alternative materials have risen substantially—cement by 27 percent, aluminum by 80 percent, and plastics by over 350 percent. These industries have not expanded simply through displacement of steel; in many applications, such as aluminum foil, they are noncompetitive with that metal. But in many other markets they have clashed head-on with steel. Thus, the construction, transportation, and container industries, which account for more than half of the total steel market, also account for more than half of the total aluminum market. (In tonnage terms, steel remains a giant among its competitors—with aluminum shipments, for example, amounting to only about 5 percent by weight of total steel shipments.)

Substitution has been stimulated by both the versatility and the price behavior of these alternative materials. The average price of steel-mill products today is about 26 percent higher than a decade ago, primarily as a consequence of a strong upsurge in the 1955-1959 period. But over the same period, cement prices have increased just 15 percent, and aluminum prices 12 percent, while plastic-materials prices have actually declined 25 percent. And even where price factors continue to favor steel, substitutes are often chosen because of advantages in appearance, ease of fabrication, or cost of maintenance and transportation.

Consider construction . . .

Steel shipments to the nonresidential and heavy construction industry were very substantial during the 1955-1957 boom, but steel usage has declined relatively since that time. This industry takes 18 percent of steel shipments nationwide but it is by far the dominant steel-user in the regional economy, accounting for some 56 percent of Western steel usage.

In construction, steel has faced a broad range of competitive materials, but concrete has made the heaviest inroads. Reinforced concrete requires only one-third to one-half of the amount of steel needed for a similar all-steel structure. Pre-stressed concrete—reinforced concrete in which steel is tensioned by controlled stretching — requires only one-fourth as much steel or one-half as much concrete as is needed for ordinary reinforced concrete, and it also offers large savings in construction time and increased flexibility of design. Pre-stressed concrete first became a major factor in the bridge-construction field, and it has come to be highly favored throughout the building field since major building-code revisions were instituted in 1963.

Aluminum has also invaded the construction market, doubling its shipments to this industry within a decade. About one-fourth of aluminum's total market is now in construction, where it has replaced both wood and steel in windows, siding, and sash, and where it has gained a foothold in larger structures through the development of curtain-wall design by modern architects. Price increases averaging $2.75 a ton over the full range of structural steel products, announced by the industry in January of this year, could help to accentuate the trend toward the use of substitute materials in construction.

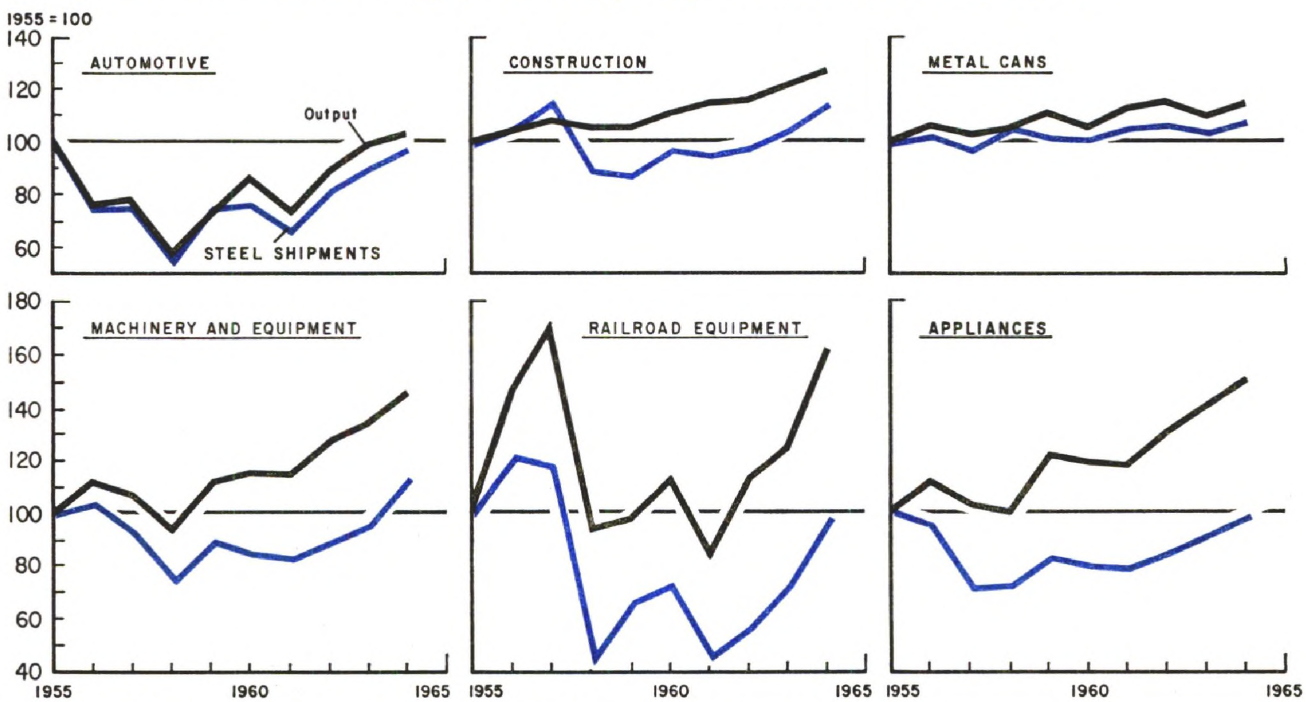
. . . and transportation

In the automotive industry, which accounts for 22 percent of total steel shipments nationwide, steel output has moved fairly closely with auto production, sharing in both the industry's earlier decline and its recent comeback. But steel has not shared completely in the auto boom, especially because of the growing consumer preference for cars which require less steel than the mammoths of yesteryear. (In the 1961-1965 period alone, compact and intermediate cars increased their market share from 24 to 41 percent.)

Aluminum, moreover, has made a spectacular penetration into the auto market. The average 1965 model contained about 69 pounds of aluminum—triple the usage of a decade ago—and the 1966 models may contain even more of the light metal. Aluminum also has taken an increasing role in the production of heavy-duty trucks, as well as trailer containers for rail piggy-back service.

In the railroad-equipment field, which accounts for about 4 percent of the national steel market, usage has been drifting down for a

Steel output lags behind output of major consuming industries, partly because of technology gains and partly because of market losses



Source: U. S. Department of Commerce; Federal Reserve Board; American Iron and Steel Institute decade. Production of railroad equipment is now back to decade-ago levels, but steel shipments to that industry are off by about 20 percent.

Technological improvements have helped to account for the lower steel-use per unit. In contrast to the prewar period, when increases in locomotive pulling power required expansion of engine size and weight, present-day technology through dieselization permits increases in pulling power with less weight than was required heretofore.

Aluminum has made inroads in the rail-equipment business since about 1960, when the railroad industry placed orders for 1200 aluminum gondola and hopper cars. Despite its higher sales price, aluminum can compete in this field because of its light weight and low maintenance cost, which is far below the $300-a-car annual maintenance cost of steel railroad cars.

. . . and packaging

Steel has also had competitive problems in the container and packaging market, which accounts for 8 percent of total steel shipments nationwide and for 18 percent of the Western steel market. Technological improvements have helped account for the relative decline in steel usage in canning, primarily because of the trend to thinner gauges of steel, but aluminum's inroads have also been a major factor. Other substitute materials have found increasing usage in plastic bottles and bottle-caps and in composite aluminum-paperboard oil cans.

Since 1960, when aluminum moved into this field, it has come to dominate the frozen citrus market and has made progress in the 10-billion-a-year beer-can market. The industry developed in turn the soft top, the pull top, and, finally, the seamless all-aluminum can. But steel fought back recently by introducing the unsoldered tin-free can, and then by adjusting price schedules in order to make these new cans cheaper than ordinary tinplate cans.

Meeting the challenge

From an earlier situation of complacency, steel in recent years has moved increasingly to meet the competitive threats of imports and substitute materials. While its research and development budget is still lower than that of any other heavy industry, it is now almost double the expenditure of the late 1950's. The industry also has attempted to develop new markets, to anticipate customer needs, to improve sales techniques—and, as always, to produce at lower costs.

A key change is the industry's growing recognition that it is participating in a dollar and not a tonnage business. It is not simply turning out tonnage and forcing the customer to decide how to use its products; rather, it is determining the needs of its potential customers and then moving to meet those requirements. One result has been a substantial improvement in the industry's profit performance—net income, which had declined by half between 1957 and 1962, recovered sharply thereafter and reached a new high in the first three quarters of 1965. The industry may be producing relatively fewer tons of steel than a decade ago, but each ton of metal is now doing a far better job than before.

—*Yvonne Levy*

Publication Staff: R. Mansfield, Chartist; Phyllis Taylor, Editorial Assistant.
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Western Digest

Banking Developments

Twelfth District weekly reporting banks increased their total credit by $166 million in December. The increase was only half as great as a year earlier, since the loan expansion was smaller and security holdings were actually reduced. But this December's loan expansion exceeded the year-ago gain after adjustment was made for the security-loan and loan-to-domestic-bank categories. . . . Business-loan demand was especially strong—up $227 million—with heavy borrowing over the tax date followed by further increases in the following two weeks. Other loans (mainly consumer) rose $100 million during the month, and real-estate loans also recorded a year-end spurt, rising by $48 million. . . . December's reduction in demand deposits adjusted was larger than a year earlier. However, the gain in total time and savings deposits was greater than in the year-ago period, mostly because of larger deposits by states and political subdivisions as well as a small increase in negotiable certificates of deposit. In early January, rates offered by banks on CD's were in the process of further upward adjustment to remain competitive with other market instruments.

Employment and Unemployment

Twelfth District nonfarm employment rose substantially in November, with manufacturing showing an especially strong (0.9-percent) gain. . . . The aerospace sector continued to recover from its earlier slump. District aerospace employment in November was 7 percent above the March-1965 level; however, the rest of the national industry boasted an even stronger recovery. . . . The District unemployment rate dropped from 5.4 to 5.3 percent in November. In the nation, the jobless rate dropped a comparable amount to 4.2 percent—and it continued declining to 4.1 percent in December.

Production Developments

District construction awards rose sharply in November, and consequently the 11-month total almost matched the corresponding 1964 total. But this comparison masked sharply divergent movements in the different sectors of the industry. For the January-November period as a whole, residential construction ran 16 percent behind the year-ago pace, while nonresidential building and heavy construction together recorded an offsetting increase. . . . Lumber orders held above year-ago levels in early December, as extremely favorable building weather in other sections of the country spurred the need for retail replacement buying. The heavy flow of orders resulted in price increases ranging from $1 to $2 per thousand board feet. . . . The Western steel industry ended the year on a strong note. Production increased 4 percent between early and late December—an even stronger gain than that recorded in the rest of the booming national industry.