

## THE WESTERN ECONOMY AND THE SPACE INDUSTRY\*

For years spokesmen for regional interests on the other side of the Rockies have demanded that something be done to reduce the lion's share of national defense contracts which California and the West continually obtain. Yet all they get for their pains is the knowledge that the West now dominates the new aerospace industry even more than it ever dominated the defense industry. The West's response to the perennial Eastern outcry has taken several forms. The pessimists in our camp argue that the West is unduly dependent on a single crop--aerospace--and worse still that this single industry is unduly dependent on the whims of a single major customer. The boosters, on the other hand, welcome the new industry and suggest that Eastern money and Western brains represent the proper allocation of resources for its rapid development. The philosophers, with their longer view, can find a spokesman in the Harvard historian, Oscar Handlin; as he suggests in his new history of American civilization, the nation's progress has occurred through the westward surge of immigrants across the Atlantic, across the wide Missouri to California and the Pacific shore, and thence onward and upward into space.

The important point, whether you're interested in the trend of civilization or just in the trend of your sales figures, is that California and the West are at the center of this crucial new development. The new products and processes which may well affect significantly the course of our economy for the remainder of this century, and probably for centuries to come, are now being developed right here. In other words, California and the West are making the innovations that may change the course of the universe and of our own smaller world here at home. Just as Chicago was the center of the railroad age, just as Detroit was the center of the automobile age, so the West Coast is now the key point in the new age of aerospace.

But what can we say right here and now about this dominant new activity? First of all, aerospace is close to being the largest single American industry, even though it has only recently become recognized as a distinct industrial sector. This industry, which includes research, development, and production of space vehicles, missiles and components, has more than doubled in size within the last five years. It now employs about 700,000 workers, or just about as many as are employed by the hitherto-dominant automobile industry.

The industry, as you all know, already has developed several unique characteristics. Unlike the durable goods industries that have long dominated the American economy, its production is based not on tin-bending but on the research and development activities of skilled scientists and engineers. Aerospace, combined with the related aircraft

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and electrical equipment industries, accounts only for one sixth of total manufacturing employment, but those industries employ more than one half of the nation's 350,000 R and D engineers and scientists, and expend more than one half of the nation's \$12 billion annual bill for R and D.

Aerospace manpower requirements accordingly differ from those of the hitherto-dominant manufacturing industries; its needs are for electronic engineers, physicists, mathematicians, tool and die makers, secretaries, etc.--but not for unskilled workers. Thus, the prime contractor for the Apollo project--a firm which had only about 4 per cent of its employees in scientific, engineering and technical categories during World War II--now is forced to allocate about 25 per cent of its employees to those categories. That firm also requires, in its supervisory and operating jobs, scientists representing about 30 disciplines and hundreds of concentrated specialties--men who can produce a space system incorporating all the latest advances in metallurgy, molelectronics, thermionics, cryogenics, ionization, and cybernetics.

The new industry is also unique in that its marketing activities are geared to an advisory and management type of professional relationship with a single major customer. It is an industry dependent not on the ups and downs of the business cycle but rather on changes in international relations, defense, and the politico-economic atmosphere in which the budget is formulated. The marketing man in the aerospace industry, instead of dealing with hundreds of fickle housewives accompanied by checkbook-carrying husbands with budget limitations that probably will not be observed, must deal with only a single major consumer--who is accompanied by checkbook-carrying clerks with budget limitations that are very real. The industry may well experience alternating periods of expansion and contraction, but it is Government policy, rather than market, considerations that will influence the result.

The new aerospace industry offers certain opportunities but also dangers for the small firm. The experience of the last several years suggests that a talented small firm can successfully bid on small contracts, but only at the cost of moving into the difficult job of hardware, which demands greater capitalization than the average small firm can support. These pressures, which of course are found in other industries as well, have placed a premium on large-scale operations. Consequently, 90 per cent or more of total employment in the industry is centered in plants with 1,000 workers or more, and small firms consistently encounter difficulty in gaining more than a one-sixth share of total space-and-defense spending.

Another feature of the new industry is the type of contract procedure that has developed under the influence of the industry's single major customer. The cost-plus-fixed-fee contract has assumed major importance, but that type of contract provides no reward or penalty for performance and also tends to bring about excessive attention to management details on the part of the industry's major customer. The need for an incentive-type contract to reward good performance, timely completion, and low-cost operations undoubtedly is obvious to all concerned, and this type

of contract thus promises to replace the cost-plus-fee contract more and more as a major management tool.

This then is the shape of the nation's dominant new industry-- an industry with unique requirements for manpower, marketing, and management. But why has the industry come to be centered here in California and the West? Why is it that this State especially, which prior to World War II was known primarily for sunshine, oranges, oil, and Hollywood, should by now dominate the key industry of the future? The causes are many and complex, but there are several features that we can all agree on.

For one thing, California is a natural location for the test centers which are so important for the aerospace industry; it has clear weather, large uninhabited areas, as well as access to the Pacific missile range. For another thing, California's pioneering research and development work lead inevitably to production contracts on aerospace vehicles. Moreover, the skilled scientific manpower that is so crucial to the development of the industry demands California living conditions; as evidence, I might note that less than one fifth of a recent crop of Cal Tech Ph.D.'s came originally from California, but more than half of that crop remained to work in California.

Whatever the reasons for California's dominance, the fact of its crucial role is unquestioned. California employs more than one third of the 700,000 workers in the aerospace industry, and the West as a whole accounts for one half of the national total. When we add in aircraft employment, we find that more than one third of California's manufacturing employment is accounted for by aerospace and related industries; this means that these activities are relatively twice as important here as they are in the rest of the country. With almost \$6 billion received in military prime contract awards in fiscal 1963, California accounts for almost one fourth of the Pentagon's total spending. More important for our subject, California accounts for about one half of NASA's spending and this is true whether you count only prime contracts or whether you consider spending on sub-contracts as well.

Now, since California and the West exert such a dominant influence on the new industry, it stands to reason that the industry will in turn exert a massive impact on the West--especially in such areas of concentration as Los Angeles, the Bay Area, San Diego, and Seattle. Moreover, given the industry's unique characteristics, it appears likely that the industry's influence will be both quantitative and qualitative; for example, consider just the employment impact in one major center, Los Angeles.

In that area probably more than 40 per cent of manufacturing employment depends on sales to NASA or the Pentagon. In other words, two out of five manufacturing jobs there are generated either directly through prime-contract work for the space-defense sector, or indirectly through sub-contract activities. In addition, probably about 45 per cent of aerospace

sales are made to prime contractors and sub-contractors in the Los Angeles area; another 25 per cent are split evenly between other California and other western firms, and the remaining 30 per cent of the sales dollar goes East.

These and other data suggest that four jobs in local sub-contract work can be generated by every ten jobs which result directly from prime contract awards to a space or defense center. In addition, there is the induced effect on the local economy caused by the consumption spending of the well-paid employees engaged in space and related work.

Consumer markets in California and the West obviously benefit from the fact that well-paid R and D men are concentrated in an industry which in turn is centered here. The local concentration of these people helps California to maintain its 25 per cent differential in per capita income over the rest of the nation, but more than that, it helps to shape spending patterns in a special way. The R and D producer, as a consumer, can be counted on to support the higher end of the price line and, in particular, to support those products which are practically synonymous with California living--suburban housing, power boats, sportswear, stereo sets, and California wines, to list just the essentials. Without too much exaggeration--but also without much statistical proof--we can credit the employees of the aerospace industry with contributing appreciably to the diversification and upgrading of the American consumer market.

But what happens to the jobs created by aerospace contracts, and what happens to the consumer markets dependent on those jobs, when the industry's only major customer changes his mind? Instead of becoming the Detroit of the new era, do we become the South Bend instead? Those questions must have occurred to many here, especially since we can no longer blithely assume that NASA spending will continue to double every year. In this connection, let me remind you that California and the West have lived through periods of uncertainty before--periods when shifts in Federal spending plans occurred here, there, and yet not everywhere. Consider California's record just in the past year. Employment in aerospace and related industries dropped by 2 per cent or more, but California's total employment in that period increased at least 3 per cent, and total personal income rose at least 5 per cent.

The longer-run answer, of course, is unclear, but a possible solution to the problem may be to enter fields subject to the discipline of the market place rather than to continue being subject to the budget discipline of the single customer. This means that the industry must gear itself to meet the market demands of businesses and consumers--undoubtedly a dismal prospect for those who remember the aluminum canoe market of the early postwar era. Even so, the optimum long-run solution for the industry, if it is to play its proper role in accelerating economic growth, lies in this field of spillover--the area which was discussed today in Dr. DuBridge's luncheon address.

As you know, the aerospace industry has been criticized for developing comparatively few useful civilian products and processes. Despite

the existence of NASA's Technology Utilization Program, the Denver Research Institute recently concluded a two-year study with the charge 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 development in the program of wonder metals and new fuel sources, not to mention the Telstar boon to communications or the Tiros-Nimbus boon to weather forecasting.

The controversy leads to the heretical conclusion that an increase in research and development spending does not necessarily accelerate the growth of the national economy. One economist, Robert Solo, points out that research and development spending has risen tremendously during the past generation but that industrial productivity has consistently hovered around its historical growth trend of about 2.5 per cent per year. He suggests, by way of explanation, that research and development has been mis-allocated in favor of the aerospace industry at the expense of growth-oriented civilian industries.

Solo argues that economic growth depends upon a very limited number of creative industrial geniuses--men who are lost to activities which contribute to civilian technological growth if they are diverted to aerospace research and development. Thus, their loss can only be offset by an intense spillover of aerospace technological advances into the civilian sector. These advances can come through a direct application of products and processes developed in aerospace exploration; for example, the items that I just mentioned. These advances must come predominantly, however, through the difficult mechanism of applying new discoveries to revolutionary advances in business and consumer markets. We may not be able to visualize what those advances will be--who, looking at the first internal-combustion engine, could visualize a freeway-centered civilization?--but the constant search for applications of space-age inventions must still be made.

Here is the challenge that the western industrialist and financier must face. On the basis of the studies I have cited, their success is by no means certain. Yet, as the businessmen most intimately concerned with the new aerospace industry, they must realize even more than businessmen elsewhere that the changes which spell opportunity tomorrow will come from the esoteric world of research-based science and science-based technology--worlds removed from the everyday experience of the typical industrial enterprise.