

ment, and it may guarantee or underwrite the sale of a specified number of standardized units of equipment or component parts manufactured for installation or use in farm or rural houses. These provisions are intended to encourage large-scale production of efficient equipment and parts, by first encouraging research and second, by guaranteeing substantial orders to the manufacturers. The total liability assumed by the government in this connection is not to exceed \$5,000,000 at any time.

The four agencies will make it easier for the man on the soil to modernize the farm home. With the exception of the Veterans' Land Act, which is limited to veterans, the three acts do not, however, provide the rate of interest inferred in the report of the Subcommittee on Housing and Community Planning. Although several other features of the report have been adopted, there is no Government sponsored farm house building program, nor has any program been designed that will tie in farm home investment with a positive long term economic policy. How soon farmers will invest in housing is not known but they will probably make their first post-war capital expenditures on farm machinery and farm buildings.

## Conclusion

Programs for improved farm housing must consider the extent to which farms provide farm income resources sufficient to pay operating expenses, cover family living expenses, and provide for necessary capital expenditures or debt payment. At the same time, adequate housing, like health, is part of a social security program. The Dominion and Provincial Governments have recognized their responsibilities in the health and welfare fields. Steps are being taken to broaden and improve social security legislation. Similarly in the field of housing the same direct action is necessary.

It should be recognized that housing programs, in themselves, will never be enough to solve the farm housing problem. Generally speaking, the farm families with the lowest incomes and the poorest prospects of increasing their incomes live in the worst houses. The only permanent solution will come through a combination of stable and adequate farm income, and full and continuing industrial employment. Better housing for farm people depends largely on better opportunities in agriculture and in industry.

# Science and Housing

By R. HAROLD DENTON

**T**HE effectiveness of scientific research and development when organized on a large scale and directed toward specific objectives has been demonstrated many times during the war. Radar, jet propulsion, the B-29, the atomic bomb, are only a few examples.

So many astounding discoveries have

been made, in fact, that people are beginning to ask themselves if the same kind of research could not solve peacetime problems equally well, providing increased job opportunities and a higher standard of living.

## Science in American Industry

The mass production industries in America have long recognized the importance of scientific research in reducing costs and increasing volume. Many industries—such as chemicals, automobiles, and petroleum—have grown great in the last twenty-five years as a direct

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result of investing a substantial part of their earnings in research and product development. The public has benefited by getting new and better products at lower costs; and labor has benefitted through higher wages, a shorter work week, and lower prices.

Plastics and Nylon hosiery are only examples of the many products which have been developed in the research laboratories of the chemical industry. As a result of research, leading to new discoveries and techniques of production, this industry has been able to increase volume tremendously and steadily lower its prices.

Organized research in the chemical industry made it possible to reduce prices even when the general price level was rising. From 1913 to 1943, wholesale prices of chemicals declined 3.9 per cent, whereas the wholesale prices of all commodities increased 11.1 per cent. The general cost of living during this period increased 29.4 per cent, and average weekly earnings increased 125 per cent. At the same time quality of chemical products improved tremendously.

In the communications industries, also, research has played a dominant role. The Bell Telephone Laboratories, for example, were spending more than \$20 million a year for research before the war. During 1944 this laboratory was operating at the rate of \$70 million a year, 80 per cent of its work being under Government contract.

Universities, also, have been carrying on a vast amount of fundamental research leading to discoveries of great importance.

Last year research activity in the United States reached a peak when the Federal Government alone spent more than \$700 million on scientific research. Most of this amount was allotted to private companies, non-profit institutions, colleges and universities, to supplement their own resources. The total amount was almost three times as much as was spent on research before the war in this country by industry and Government combined. There is evidence from com-

petent authorities that this tremendous research effort played a decisive role in winning the war.

### **More Jobs—Better Living Standards**

The same research techniques which were used so successfully during the war can be used just as effectively in developing new products and new techniques to increase job opportunities and raise living standards in the years ahead.

\*As America is becoming science minded, people generally are beginning to recognize that science creates jobs instead of throwing people out of work. This is one of the more significant changes in social thinking which has come out of the war.

Prior to the war, the belief that there is only so much work to be done and that discoveries and technological advances cause unemployment persisted in many important segments of American opinion. Many labor restrictions for example, reflected this philosophy and attempted to spread the available work as far as possible by prohibiting the use of labor-saving devices or restricting the amount of work which men were permitted to do in a day. Restrictions of this kind were particularly serious in the building trades.

Similar restrictions on volume were practiced by dealers and manufacturers in their pricing and distribution policies, following the false belief that there is only so much business to be done. Dealers, in many instances, insisted that all this business be routed through them; and manufacturers set prices high enough to insure a profit on a low volume.

The tremendous capacity of American industry, working with the newest and most efficient techniques available, was so effectively demonstrated during the war that most people, including representatives of both labor and industry, seem willing to accept the idea that there is an unlimited amount of work to be done, and that scientific progress with the resulting increase in productivity is the only road to higher living standards. Instead of prohibiting or restricting the use of new discoveries, the emphasis seems now to be placed upon harnessing these discoveries

for the benefit of labor, industry, and the general public.

### Science Can Reduce Housing Costs

Among the many peacetime fields in which science can be advantageously put to work, housing is one of the most important. The housing industry has fallen far behind many other industries in technology, largely as a result of inadequate scientific research in the past.

Probably no other single field in America holds greater promise for development than housing. A dynamic housing industry can set the pace for the whole economy. No other single field offers as great opportunities for sound investment. For this reason, housing may well furnish the key to full employment. But an aggressive and comprehensive program of scientific research is needed to make housing a dynamic force, with production stabilized at a high level.

The curtailment of housing construction during the war has greatly accentuated the need for new housing. Even before the war, however, the condition of housing, not only in the United States but in most other countries as well, had reached such a state as to present a serious social and economic problem. Striking proof of this is the fact that in the entire forty-year period from 1900 to 1940 there were not enough new dwelling units built in the United States to provide even for the increased number of new families. Only 17,791,000 non-farm dwelling units were built during this period, whereas 17,967,000 new non-farm families were created, leaving a deficit of 176,000 dwelling units. This means, in effect, that no new houses at all were built to replace units which became obsolete or worn out. The same situation prevailed during the shorter period from 1913 to 1940 when despite the building boom of the 1920's, not enough new houses were built to provide for the increase in families.

The accumulated shortages in housing, resulting from insufficient building both before the war and during the war, are

so great that it is estimated  $1\frac{1}{4}$  million new units are necessary each year for the next ten years in the United States to meet new needs and to make a good start toward bringing the entire housing supply up to a reasonable standard.

The housing picture in Canada is even more unhappy. Although exact figures are not available for the Dominion, estimates of the Subcommittee on Housing and Community Planning of the Advisory Committee on Reconstruction show that in the years 1921-1939 approximately 640,600 new dwellings were constructed. Many of these "new" dwelling units were constructed by reconversion or remodelling of old dwellings in the 'thirties, so actual new building was even less. Annual additions to the housing supply in the first decade after the last war varied from 32,000 in 1921 to 50,000 in 1928; during the worst of the depression years (1933) the figures fell as low as 14,000 and rose only to 32,000 again by 1939.

The final report of the Subcommittee on Housing states, "Throughout the period, in the good years and bad, the number of new dwellings required annually should have been considerably higher, if any allowance at all is made for inadequacies of accommodation due to overcrowding or the inability of low-income groups to secure satisfactory housing."

More significant perhaps are comparative figures showing the great discrepancy between residential construction carried out in Canada and in the United States. In terms of per capita expenditure, in the peak year of house building (1925) some \$45 per person was spent in the United States as compared with about \$22 for Canada's peak year of 1928. Canada has spent, in proportion, considerably less on residential construction than Great Britain or the United States. "The number of dwelling units built during the 'twenties did not even approximate the requirements for a good standard of housing accommodations for Canadian cities and

towns, and rural building probably lagged even more."

The Subcommittee estimates a minimum housing program for urban Canada in the first post-war decade should call for construction of approximately 535,000 units, included the accumulated building need (160,000) and the annual minimum building need (375,000) or 53,500 units per year, beginning in 1946.

This volume of housing cannot be built unless costs are cut substantially. Careful studies of the relationship between family incomes and housing costs are conclusive on this point. The simple fact is that an adequate volume of housing was not built before the war because not enough families could afford new homes, and the same situation will continue after the war unless costs are greatly reduced.

Viewed in this light, the housing problem breaks down very simply. There is a tremendous need for housing, not only as a means to improve living conditions, but to create jobs and serve as one of the principal motivating forces in sustaining full employment. The necessary volume of housing will not be built, unless costs are substantially reduced. Costs cannot be cut to the necessary levels except through the development of more efficient methods of production and organization in the building industry. Scientific research has solved similar problems in other industries, and it is only reasonable to expect that scientific research could solve the problem of high costs and low volume in housing if directed at the problem as a specific objective.

### **Housing Research Should Be Comprehensive**

The research should be comprehensive and should cover every aspect of producing, distributing, and assembling all the many pieces and parts which go into a house. The approach should be to reduce the number of pieces and parts and to simplify operations all along the line, from the original source of raw

materials to their final assembly at the site.

Most research in housing has been spotty and has been directed at relatively small elements of the house. Although the structural shell of the house represents 60 percent of the cost of the house and lot, very little research has been undertaken to reduce the number of pieces and parts making up the walls, partitions, floors, and other structural elements of the house.

Housing research should start with the materials themselves, because the nature of building materials governs to a very large extent the efficiency with which they can be assembled on the site.

Enough has been done to make certain that intensive research could develop the kind of multi-purpose materials which could be molded into wall, roof, and floor panels in the initial processing. This would permit selling panels through regular distribution channels for use by regular builders and architects, instead of 2 x 4's, bricks, and other small pieces.

While the largest element of cost is in the structure itself, and the least technological change has occurred in this area, research should cover improved heating systems, kitchen units, and utilities, as well as community facilities and services.

The success of such a research program in reducing housing costs would depend upon the size of the program and aggressiveness with which it was carried out. The problem is of sufficient importance to justify the full mobilization of the technical resources of industry, educational institutions, and Government laboratories which can contribute to a solution. *Because much of the necessary research involves the application of principles developed in other fields, scientists not specifically familiar with the problems of housing can greatly assist in the work.*

### **Government-Industry Co-operation Needed**

Because the building industry is made up of so many small businesses, with the

few large manufacturers concerned only with a particular material or relatively small aspect of the problem, Government support and assistance in the research will be necessary if the results are to be speedy. The experience gained through the co-operative programs of research between Government and industry during the war furnishes a good pattern for scientific research in housing.

The Government program should supplement that of industry rather than compete with it, but there are many important gaps where Government-sponsored research is necessary. Government-supported research in housing can be done partly in existing laboratories and partly through contracts with universities and other research institutions. But to provide a comprehensive program and furnish the kind of assistance which is needed to solve the problem of excessive housing costs in a reasonable time—and *time is an important factor*—the Government should develop its own laboratories and research facilities to work specifically on the technical problems in housing which cannot adequately be covered otherwise.

### Wide Use of Results

Information developed as a result of such a comprehensive research program should be disseminated widely throughout the world, and a system for exchanging technical information among all countries should be established. Discoveries made as a result of Government-financed research should be made freely available to everyone, without restriction.

In the past, technical information on new developments in housing has been poorly distributed, both in the United States and among various countries. Many improvements in building techniques are known but are not widely used, simply because builders and the industry in general have not been informed about them. For example, many power-driven tools have been developed for use in housing construction, but generally such equipment is not used except by some of the larger builders. In England a mobile demonstration of power-driven hand tools

has been prepared and is touring the various cities and towns in England, Scotland, and Wales, to show by actual demonstration the savings which such equipment can achieve. Practical demonstrations of this kind are very useful in presenting technical information on more efficient building methods in a form which can be easily understood.

Building codes present an important barrier to the introduction and use of many improvements in building techniques. During the war in the United States many rigid building code restrictions were waived by communities having war industries to permit rapid construction of temporary housing and to conserve materials. With the end of the war, however, there is danger that local regulations will revert to their former status and will again present a serious handicap to the development and wide use of more efficient methods and materials.

Much good work is being done, both in Canada and the United States, looking toward liberalizing code requirements and providing greater uniformity among the various communities. Because of the urgency of the problem, work in revising building codes should be accelerated; and the general principle should be clearly established in all communities that any new building materials or methods may be used so long as they produce a structure which adequately protects the public safety and health.

There is often a considerable gap in time between a new discovery and its commercial application and use. This is true, particularly, in an industry such as housing which is comprised of many thousands of business enterprises, each of which performs only a relatively small part of the function of producing a completed house. It is important to remember that new discoveries or developments in themselves will not lead to lower housing costs; it is only the commercial application of improved materials and methods which will secure better houses for less money. To insure rapid and widespread

use of new discoveries in housing, it is desirable that pilot plant operations and practical demonstrations be conducted in many instances.

### **Lower Costs—More Jobs—More Business**

Lower housing costs, bringing better and more houses, offers great opportunities for more jobs and more business.

In the past the seasonal and haphazard nature of employment in the building trades has created deep-seated fears among building mechanics and has caused them to devise protective measures which seek to reduce some of the uncertainties. Before the war the average building mechanic could not be sure of more than 150 to 175 days of work a year. Completion of each job often meant that the worker would be unemployed for several days or even months. It is only natural that under these circumstances the workers through their unions would seek to extend the work on any particular house or project as long as possible.

Restrictive practices have been widely prevalent in the building trades, and instead of preventing unemployment, they have contributed greatly to unemployment of building workers by raising costs and curtailing the market for new houses.

Among the restrictions which have been imposed in the building trades, the following examples will serve to indicate their general nature. Painters' rules have often prohibited the use of paint brushes wider than 4 inches except with water paint, and have provided that paint sprays could not be used. Plumbers have often refused to install fabricated materials, such as pipe which has been threaded before coming to the job and fixtures on which the trim has been put in place before reaching the site. In some instances plumbers, bricklayers, lathers, and other trades have specifically limited the amount of work which could be done in a day. Common laborers have been prevented from doing such simple tasks as wiping up paint on a job and carrying

materials from truck to place of use in order to provide more work for the skilled mechanics.

There are many similar examples of restrictive practices in the building trades, all of which spring from the common fear of unemployment. If this fear can be removed, most of these restrictions on output will undoubtedly disappear. Evidence of this is the fact that during the war, when there was more work than men to do it, there were few instances of deliberate restrictions on output.

It is somewhat unrealistic to expect a worker not to nurse his job and make it last as long as possible, unless he can be assured of continuous employment and a good annual income. Development of efficient methods and materials, accompanied by a better organization of the building industry which will integrate its operations more effectively, is the best way to insure steady employment and good annual earnings. The reduction in housing costs which will result from technological advances will greatly expand the housing market and sustain volume at very much higher levels than have ever been known before, giving greater security to labor.

An important problem which should be investigated in the research program should be the reduction of the seasonal factor in house building. Russia, for example, has developed a satisfactory method for performing concrete work in the extreme temperatures of Russian winters. Prefabrication has demonstrated that a greater proportion of the building work can be done inside, greatly reducing the weather factor. Development of materials which could be produced in panel form in the initial processing would similarly reduce the amount of outdoor work at the site, thereby permitting construction during a greater part of the year than is possible with present methods.

Better materials and methods, leading to lower costs and volume production, would stimulate the development of larger local building organizations. One possible result along this line is the dealer-builder

organization which would stock the materials and parts, prepare the site, build the house, arrange financing, and handle all continuing operating problems such as maintenance, tax payments, etc. Such an organization would be in a position to provide continuous employment throughout the year for its employees.

It is true that technological advances of the kind which are needed before housing costs can be substantially lowered will cause a shifting of skills and may result in basic changes in skill requirements. The natural desire of certain crafts to maintain themselves has created opposition to any radical changes in building techniques. This opposition again springs from the fear of unemployment.

Technological advances in house building will result in more jobs—not less. They will give building labor higher and steadier yearly earnings and at the same time will give them better houses for less money. It is a well-known fact that most building mechanics can not now afford new houses as good as those on which they work.

Proof that new discoveries do not throw men out of work is given in the experience of the automobile industry. The local carriage and wagon makers argued that the automobile would ruin their business and take employment out of town to some central automobile factory. Yet, by 1939 there were many thousands more people engaged in distributing and servicing automobiles in the communities all over the country than could ever have been employed by the carriage and wagon makers.

In fact, the automobile business has grown to such an extent that in 1939 there were actually more people engaged in selling new cars in local agencies, not counting used car dealers and garages, than were engaged in distributing all kinds of building materials locally including lumber, heating and plumbing equipment, hardware, electrical supplies, etc. This is a very significant fact. Thus, in 1939 there were 314,588 persons engaged in selling new cars compared with 281,-

405 persons engaged in retailing building materials and equipment. In addition, there were 231,475 active proprietors of filling stations and 235,527 employees.

The automobile industry has generated a tremendous number of jobs, not only in cities where the factories are located, such as Detroit, but in practically every community in the country. In fact, it has been stated by competent authorities that the automobile set the pace for the prosperous 1920's, and that what we need now is a new industry equally dynamic. Housing can be that industry if it will gear itself to the job by bringing its methods up to date through a broad program of scientific research and product development.

### Opening Up a New Market

The real opportunity in housing lies in opening up the market to middle-income families. The higher-income families can afford good housing now, and can pay for handicraft methods. A great many of these families will continue to want custom-made houses of brick, stone, or lumber. They will also want them built by skilled craftsmen—bricklayers, carpenters, plumbers. Moreover, important changes in techniques do not occur overnight, and there will be plenty of time to make the necessary adjustments and provide training for the new skills.

The middle market constitutes an entirely new market for better housing, and it is this market toward which scientific research should be directed. When costs are reduced sufficiently to enable a family of moderate and average income to afford a good new home, the large replacement market will be opened up and housing standards will rise rapidly.

Ultimately, it may require cost reductions of 30, 40 or 50 per cent for the same quality house to furnish adequate housing for all families. Scientific research has solved many problems which have appeared impossible at first glance. It can solve this problem too, if it is organized on a scale commensurate with the importance of the problem.