

NRC Publications Archive Archives des publications du CNRC

The Future for Agriculture and Building Shebeski, L. H.; Hutcheon, N. B.

For the publisher's version, please access the DOI link below. / Pour consulter la version de l'éditeur, utilisez le lien DOI ci-dessous.

Publisher's version / Version de l'éditeur:

<https://doi.org/10.4224/20378964>

Technical Paper (National Research Council of Canada. Division of Building Research), 1967-11

NRC Publications Archive Record / Notice des Archives des publications du CNRC :

<https://nrc-publications.canada.ca/eng/view/object/?id=6c610d47-9c2c-45bc-ab5c-2ceb5c9958c7>

<https://publications-cnrc.canada.ca/fra/voir/objet/?id=6c610d47-9c2c-45bc-ab5c-2ceb5c9958c7>

Access and use of this website and the material on it are subject to the Terms and Conditions set forth at

<https://nrc-publications.canada.ca/eng/copyright>

READ THESE TERMS AND CONDITIONS CAREFULLY BEFORE USING THIS WEBSITE.

L'accès à ce site Web et l'utilisation de son contenu sont assujettis aux conditions présentées dans le site

<https://publications-cnrc.canada.ca/fra/droits>

LISEZ CES CONDITIONS ATTENTIVEMENT AVANT D'UTILISER CE SITE WEB.

Questions? Contact the NRC Publications Archive team at

PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca. If you wish to email the authors directly, please see the first page of the publication for their contact information.

Vous avez des questions? Nous pouvons vous aider. Pour communiquer directement avec un auteur, consultez la première page de la revue dans laquelle son article a été publié afin de trouver ses coordonnées. Si vous n'arrivez pas à les repérer, communiquez avec nous à PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca.

Ser
TH1
N21t2

no. 266
c. 2
BLDG

THE FUTURE FOR AGRICULTURE AND BUILDING

by Dean L. H. Shebeski
University of Manitoba
and N. B. Hutcheon
Assistant Director
Division of Building Research

ANALYZED

Two papers presented at the
Saskatoon Jubilee Symposium
29 September 1966



Ottawa

November 1967

Price 50 cents

NRC 9889

CISTI/ICIST



3 1809 00026 4637

NATIONAL RESEARCH COUNCIL OF CANADA

DIVISION OF BUILDING RESEARCH

THE FUTURE FOR AGRICULTURE AND BUILDING

Two papers presented at the
Saskatoon Jubilee Symposium
29 September 1966

ANALYZED

by

Dean L. H. Shebeski
University of Manitoba
and

N. B. Hutcheon
Assistant Director
Division of Building Research

Technical Paper No. 266
of the
Division of Building Research

OTTAWA
November 1967

3599630

AGRICULTURE

by

Dean L.H. Shebeski

College of Agriculture - University of Manitoba

It is particularly fitting that this symposium, commemorating sixty years of progress and development of the City of Saskatoon, should open with a paper on Education and close with a paper on Agriculture.

EDUCATION because educated people are basic to the progress, development, and wealth of any nation. It was on this premise that Dean Bladen at the Resources for Tomorrow Conference held in Montreal in 1961 argued that, "...much of the 'expense' properly incurred in education is really an 'investment'...."

AGRICULTURE because the most critical problem facing humanity in the decades ahead is that of continuing to provide food for the exploding populations.

It is perhaps difficult for those who live in Western Canada to visualize or take seriously the increasingly repeated warning that unless man brings his rate of increase under control famines of unprecedented proportions will be inevitable. In Saskatchewan, an all-time record high wheat crop has been harvested with an all-time record high in yield per acre. In 1905, one million, one hundred and thirty thousand acres were planted to wheat in this province and, with an average yield of 23.1 bushels per acre, 26 million, 107 thousand bushels were harvested. Sixty-one years later - 1966 - the estimated seeded acreage in Saskatchewan of 19.7 million acres at an estimated yield of 28 bushels per acre should give this province a record of 551 million bushels. This province's over-all grain crop will be worth well over a billion dollars.

It should be obvious that any increase in volume of agricultural production, such as that enjoyed in the West this year, has an immediate and pronounced effect on the urban business community. Forty to fifty per cent of the business conducted in Canada is directly or indirectly related to agricultural products - by way of illustration, banks, feed mills, fertilizer plants, food processing plants, and transportation.

We have come a long way in the last sixty years. We have seen striking changes in agricultural practices, particularly in mechanization; in fertilization practices; in weed and insect control; in our ability to contend with drought. In Saskatchewan as the horse was eliminated as a source of power, nine million acres previously used for feeding horses were converted to producing food for people.

During this rapid period of expansion, we have had to contend with surpluses, with storage a major problem. We find it difficult, therefore, to visualize the evil spirit named "Hunger" which hovers over the birth of each succeeding generation and which has been described by Dr. H. L. Trueman in the following terms:

"I am HUNGER. I take the bodies of men and women and children, and twist them and torture them and corrupt them until it is a travesty to say that they were ever made in the image of God. I take away from my victims the strength to help themselves, the will to grow the food they need, to house themselves, to rule themselves for the common welfare, even the desire to walk the good earth in strength and gladness.

"I am HUNGER. I hold sway over half of all mankind."

I make no apology for exposing you to an examination of what I firmly believe to be the most critical problem facing humanity: that of continuing to provide adequate sustenance. This is a problem that is to be featured at Expo 67 in the Agriculture Pavilion and I quote from advance publicity:

"Featured for the first time at an International Exhibition, agriculture will be shown in a new light - its tremendous technical achievements, and how all humanity depends on the farmer in feeding this hungry world.

"The population explosion and how, as a result, man must find new ways of producing more food will be dramatically told. A "people machine" - turning out two plastic bodies per second - will dramatize the rate of population increase. About 32,000,000 people will be added to the world during Expo 67 - a third of whom may never get enough to eat! "

In April of this year, United States Agricultural Secretary, Orville Freeman, told the Overseas Press Club in Washington

"By 1984 all the combined food production, on all the acres, of all agriculturally productive nations, will not meet the food requirements of the less developed countries."

By 1984 man loses his race with famine.

If further support is necessary for my contention of the seriousness of the problem, it is not hard to find.

ARNOLD J. TOYNBEE, British Historian:

"If atomic weapons do not destroy all life, preventive medicine applied by public health authorities will allow the numbers of the human race to multiply up to starvation point and beyond it, unless we can bring ourselves quickly to change our habits, and our traditional attitudes, in regard to the procreation of children."

ALBERT EINSTEIN:

"Progress of hygiene and medicine has completely altered the earlier precarious equilibrium of the quantitative stability of the human race. I am therefore firmly convinced that a powerful attempt to solve this tremendous problem is of urgent necessity."

VANNEVAR BUSH, former President, Carnegie Institution of Washington:

"The world's population is increasing at a rate which renders distress, famine and disintegration inevitable unless we learn to hold our numbers within reason."

WINSTON CHURCHILL:

"If with all the resources of modern science, we find ourselves unable to avert world famine we shall all be to blame but a peculiar responsibility would rest upon the scientists. I do not believe that they will fail, but if they do, or were not allowed to succeed, the consequences would be very unpleasant because it is certain that mankind would not agree to starve equally, and there might be some very sharp disagreements about how the last crust would be shared. This would simplify our problem in an unduly primordial manner."

The quotations simply state the seriousness of the problem, but do not indicate elements of time or what should be done. It is imperative that an accurate assessment be made of the magnitude of the problem on the basis of numbers of people to be fed, the land resources available, and the time elements involved.

Numbers of people and the time element: Although vital statistics for all countries are not by any means complete or accurate, United Nations' studies are providing more accurate information year by year. In countries with inadequate vital statistics, intensive sampling has been carried out. According to Dr. J.M. Jones in his book, Does Over-population Mean Poverty?, as newer and more complete data become available previous estimates usually are found to have erred on the low side. On the basis of United Nations' vital statistics there can be little doubt that the present world population is slightly over 3.3 billion people and is increasing at a rate of about 2.5 per cent per annum.

The time required to double a population depends on its rate of growth, and seemingly small percentage increases in the annual rate of growth result in very rapid total increases in population. The following table indicates the relation between rate of increase and time required for a population to double itself:

<u>If the Population Increases Each Year at</u>	<u>The Total Population Will Double in</u>
1.5 per cent	46.2 years
2.0 per cent	34.6 years
2.5 per cent	27.6 years
3.0 per cent	23.1 years
4.0 per cent	17.3 years

You may be interested in some of the current rates of increase in the more densely populated areas of the world as extracted from United Nations' Demographic Yearbooks:

<u>Country</u>	<u>Annual Rate of Increase (per cent)</u>
U.S.S.R.	1.8
China (Mainland)	2.3
Taiwan	3.3
India	2.6
Pakistan	2.5
Brazil	3.1
Ghana	4.0

Mexico, with a population of forty million, was listed at 3.4 per cent, but in an address given by Dr. N.E. Borlaug on "Food Production in a Fertile World" in Winnipeg several months ago, it was stated that recent information indicates the current population growth rate of Mexico to be 4 per cent per annum which, as previously stated, means doubling in 17.3 years.

Thailand, on the basis of their 1954-56 population statistics, was considered to be increasing at 2.4 per cent per annum. The latest figures indicate that the present rate of increase is now 4 per cent per annum. With reference to Thailand, Dr. P.C. DeKock from the Macaulay Institute, Aberdeen, Scotland, in speaking last January on the Agricultural Dilemma, stated:

"It is said that a Thai woman marries at sixteen and until the age of forty-three produces about twenty-six children of which three survive infancy, but that is one too many."

If Dr. DeKock's statement about the number of children is reasonably accurate, we can obviously expect an increase over the current rate of 4 per cent per annum because medical advances and sanitation will reduce infant mortality in Thailand far sooner than other agencies will be able to influence a reduced birth rate.

In the light of the rates of increase presented for individual countries, it is logical to accept the United Nations' projection on a world basis as given by W.J. Parker, President of Manitoba Pool Elevators,

in his paper, "Food - the World Market":

"...it is estimated that by 1995, only thirty years hence, the population of the world will have reached between seven and eight billion."

Similar figures - 7, 410, 000, 000 people by the year 2, 000 AD - were forecast in an impressive illustration appearing in the June 1966 issue of Fortune magazine.

Although the basis for these forecasts or projections are sound, I am firmly convinced that the world population will not reach seven billion by 1995 because we, the agricultural community will not be able to produce sufficient food to sustain so large a population in so short a space of time. The current famine in India is a forerunner of greater famines in the next three decades in the more densely populated sections of the world. Man the Provider will not be capable of providing. As a basis for this statement, let us examine the second phase of the problem, our land resources, and what we know about their productivity and about the people who are charged with the responsibility of making the land produce.

Land resources: It is not difficult to determine the actual land area of the earth. According to the Foreign Agricultural Economic Report No. 11, "Man, Land and Food," the world's land surface currently is estimated at 32.9 billion acres. Of this, 3.5 billion acres, or just under 11 per cent of the total, is classified as arable land and land in tree crops. The amount actually planted to crops in a given year is considerably less, usually under 2.4 billion, but using the figure of 3.5 billion acres now classified as arable the current ratio of cultivable land and population is one acre per person. In Canada we have about six acres of cultivable land per person. In the light of today's technology competent authorities estimate that it should be possible to add another 1.3 billion acres to the world's food-producing areas, but the increasing populations are occupying land and taking agricultural land out of production more rapidly than new, marginal lands are being brought into production. Thus, over the next thirty years we can expect a decrease rather than an increase of land available for crop production as an additional three and one-half billion people arrive to occupy space.

We in Canada and the United States particularly are wasteful of agricultural land, and it is important to note that in most instances the land that is lost to agriculture is the most productive land in the country and therefore disproportionately large in terms of acres. This is so because of the pattern of original settlement when agriculture was by far the most significant industry. It was natural that cities would be founded and roads built in the most thriving agricultural communities.

At the "Resources for Tomorrow" Conference held in Montreal in 1961, A.D. Crerar pointed out that in the areas of Winnipeg, Toronto, Hamilton, and Montreal from 1951 to 1956 approximately four hundred acres of farm land were removed from agricultural production with every one thousand increase in population. During the same period, one thousand acres of farm land were lost at Ottawa and Quebec per one thousand increase in population. According to DBS, the total farm area occupied in Canada in 1956 was less than that in 1951 and a still further loss occurred in the last five-year period.

Coming back to the world scene, it is very safe to conclude that if the population were to reach seven billion in thirty years, we would be charged with the responsibility of producing food for that population from less than one half acre per person.

There are many who believe that this can be done. In a recent issue of the Family Herald under the heading of, "Some Thoughts on Food Production," Gilbert MacMillan a widely-known farmer who has a dairy operation at Huntingdon, Quebec, expressed himself as follows:

"We are continually being warned that unless some drastic steps are taken to control the increase in population which is taking place all over the world, then the human race will eventually starve to death. I cannot quite agree with this dire forecast, because of the progress that science has made in combatting many of the pests and diseases that hampered food production."

In the Western Producer, Harry Hargrave, Chief, Land Use Service, P.F.R.A., is quoted as stating that Brazil could produce four times as much agricultural produce as the United States, that she has the agricultural potential to feed one billion people.

Dr. Jean Mayer, Department of Nutrition at Harvard, firmly believes that man can continue to feed himself indefinitely, - that there is an abundance of land resource. Just a year ago last December in "Nutrition Review," Dr. Mayer wrote:

"Our population is increasing faster than it ever has; our major nutrition problem is over-weight, our major agricultural problem is our ever-mounting excess production."

Reports such as these are most disturbing because, although they are made by responsible people in good faith, they are not supportable on the basis of known experience on the world scene and they tend to minimize the danger and the urgency of the problems we face. Perhaps the best example that can be used of how difficult it will be to feed seven billion people from three and one-half billion acres is to look at the situation in Britain. Britain is an advanced country agriculturally, and a most productive one. Britain is classified as one of the twenty-five major wheat-producing countries of the world (major producing countries are defined as those having two million or more acres of wheat). Of the twenty-five Britain has by far the highest average wheat yields - 54.8 bushels per acre. By comparison, Canada averages 20.9 bushels; U.S.A. 25.1; Argentina 17.6; U.S.S.R. 11.9; Australia 18.4; etc. Even if these countries could double their average yields, they still would not be able to match Britain's average yields. This ability to produce in Britain is not restricted to wheat. It applies to a wide variety of agricultural products. Despite this high level of production, Britain, which has one-half an acre of cultivable land per person, produces only 55 per cent of her food. Britain currently imports more than 4.5 billion dollars worth of food annually. In the 18 November, 1965 issue of the "New Scientist," Sir William Slater in an article entitled, "Could Britain Feed Herself?" answers the question in the negative.

Can we conceive that on a world basis we will be able to match Britain's productivity within thirty years? Climate alone in much of the agricultural areas would prohibit matching such productivity. And if Britain is not able to produce sufficient food from one-half an acre per person, surely on a world basis we will not be able to do so.

An even greater limiting factor to adequate food production than our land resource is the human element that is directly or indirectly charged with the responsibility of making the land produce. One such group is the primary producer, the farmer. Professor L. B. Siemens succinctly stated the problem in an article summarizing the proceedings of a Conference on Agricultural Education in Asia and I quote:

"Another barrier to the imperative of all-out agricultural production through education lies in the multitude of farmers to be reached with production technology, and with the general state of literacy. Of the billion people in Asia (not counting Red China) about seven hundred million are living or working on about one hundred and fifty million farms. Of the total population in these countries, about 40 per cent of those over fifteen years of age cannot read or write. Imagine, for instance, the task of setting up and maintaining an agricultural education system for the more than sixty million family heads presently farming in India, seventy per cent of whom are illiterate."

Even here where we have no illiteracy, what percentage of our farmers make use of known technology to increase production?

Many of us easily could be misled if we were to accept what we read without a critical examination of the actual facts. The eminent international agricultural economist, Lester R. Brown, in his recent book, Increasing World Food Output shows Canada as increasing her wheat yields by seventy-one per cent. Brown used the

very low five-year average from 1935-39, which included drought in Saskatchewan and rust in Manitoba and compared this with the 1961-62 average, from which he excluded the 1961 data because it was a dry year. But according to DBS, the latest available five-year average, 1959-64, of 19.6 bushels per acre is considerably lower than the 1911-1916 average of 20.8 bushels per acre. It is this type of realistic statistic that most probably led to Dr. DeKock's statement,

"But can anyone point to a vast improvement in the yields of wheat in the Canadian Prairies over the last thirty of forty years? The prairies have yielded and presumably will yield twenty bushels per acre for many years to come."

Although I am confident we will upgrade our wheat yields in Western Canada, we will have to admit that despite our high level of literacy and technology, despite the availability of fertilizers, of chemicals for weed control, we have not been able to obtain tangible increases in yield over what our farmers obtained fifty years ago. Why then should we expect to be able to double our yields in the next thirty years as we and all other countries must if seven billion people are to be fed?

Earlier I stated that "the current famine in India is a forerunner of greater famines in the next three decades because the agricultural community will not be able to produce sufficient food to sustain the expected population in so short a space of time. It is not that the land is not capable of producing sufficient food, but that man has not even begun to mobilize his resources to take the kind of action necessary to avert major catastrophes. To date, we in Canada have really only given lip service to the problem. We have too much diversity of opinion in our agricultural ranks to convince our government or any other governments that man's survival depends on a mobilization of resources similar to the type of mobilization we have demonstrated ourselves capable of achieving during the last two world wars. We have not submitted any plan of action that has really influenced government policy, and it is not the politician who should be blamed. The agricultural community has not made its voice effective.

Consider what action has been taken since the assessment of renewable resources in Montreal in 1961:

The Government has established a Canadian Council of Resource Ministers who concern themselves with provincial and national problems in the renewable resource fields of fisheries, forestry, wild life, recreation, water, and land. It is rather ironical that the Council of Resource Ministers do not include government representation from agriculture, a major user of land and water. ARDA has been established (The Agricultural Rehabilitation and Development Act) whose major function appears to be the taking of marginal agricultural land out of production and the rehabilitation of people from depressed areas.

The urban sprawl continues unabated, however, and agricultural land is being irretrievably lost at an increasing rate. Industries, more and more, are developing sprawling, one-storey buildings with adequate parking facilities in appropriately landscaped settings. Housing developments provide larger lots and more recreational space for new and growing communities, and these developments in themselves are good. But should the developments continue where they do?

I look at Winnipeg, set on fertile lacustrine soils at the junction of the Red and Assiniboine Rivers. Expansion can take place only on good agricultural land. Sixty miles to the east are vast stretches of non-agricultural land covered with forests, lakes and streams. It is from this area that Winnipeg obtains water. It is from this area that Winnipeg brings in hydro-electric power, and it is to this area that masses of people migrate every weekend for relaxation on highways some of which have taken out of production as much as forty acres per mile. Why not establish a greenbelt around Winnipeg and other such cities and establish industries and new cities where water, power and resort areas are more conveniently located?

We will continue to lose the Niagara Peninsula to urbanization, we will continue to lose the Fraser Valley, because we do not believe sufficiently that good agricultural land is a precious resource requiring conservation.

How much could we increase the productivity of the Prairies if large areas could be irrigated, particularly forage productivity and livestock carrying capacity? We do not know the answer and, unfortunately, we are doing very little to find it.

Some of you may be familiar with the one hundred billion dollar proposal of the North American Water and Power Alliance, which conceives the collection of one hundred and ten million acre-feet of water per year from northern Canadian rivers and the diversion and distribution of this water to the water-scarce areas of Canada, the United States, and Mexico. Of the total diverted water, eighteen per cent is visualized for use in Canada, sixty-five per cent for use in the United States, and seventeen per cent for use in Mexico. According to the Financial Post (15 January, 1966) "Alberta says no water for the U.S." This same report indicated that British Columbia was opposed to further water exports. Ottawa has so far taken a distinctly cool attitude to NAWAPA. Its position is the same as that of Alberta and British Columbia: Canadian needs must be established first.

But how quickly are we attempting to establish Canadian needs? Can we afford to export water? According to Professor Kuiper, a hydraulic engineer, the available water flow from the Nelson, Churchill, Mackenzie and Yukon River systems is approximately three hundred million acre-feet per annum. The United States' demand is estimated at ninety million acre-feet. Surely, here is a type of program that needs immediate and thorough examination because it will take fifteen to twenty years of planning and building, even if we were to start now.

I have suggested only one type of program that conceivably could have a tremendous impact on food production potential in Canada. Our major role, and the role of all developed countries, is to initiate immediately crash programs in the underdeveloped countries at war time levels of expenditure because we must wage an all-out war against the circumstances and factors that threaten mankind.

Top priority must go to the field of education. Collectively we must muster literally armies of teachers to go to the problem areas

of the world and as quickly as possible eradicate illiteracy. We require a literate world to industrialize, but even more important to appreciate and accept modern means of population control. No matter how quickly we develop a gigantic program in education it will take decades to complete, and despite our best efforts we will not be able to avert famine in densely-populated areas of the world as populations mushroom towards the predicted seven billion people before the year 2,000. But at least this type of program will hasten the day when man will stabilize his growth at a rate commensurate with his capability to provide any standard of living he should choose.

An almost equal top priority must be the all-out drive in increasing agricultural productivity on the world's limited acreage. The time element at our disposal, if we wish to avert serious and increasing famine, is so short that the urgency cannot be sufficiently emphasized.

I have attempted to indicate that we as people have not accepted the warning of various world leaders whom I have quoted earlier, and that the blame must surely lie with the Agricultural profession. How can we influence government policy if we do not speak with one urgent, insistent voice indicating that under the existing distribution of man's resources the agricultural community cannot continue to provide?

That we have not influenced government policy might best be appreciated if we look at the American New Administration Budget as reported in the January 31, 1966 issue of Newsweek.

		<u>In Billions of Dollars</u>	
		<u>1966 (est.)</u>	<u>1967 (est.)</u>
Defence	56.6	60.5
Education	2.3	2.8
Agriculture	4.3	3.4

Before summarizing, I would like to take a few more minutes of your time to look at the next few decades for Saskatoon and the Prairies as they pertain to agriculture. In contrast with many other areas of the world, I cannot help but believe that we are entering an unprecedented era of prosperity. Demands for agricultural goods and services will continue to increase. According to Dr. W.J. Parker,

President, Manitoba Pool Elevators, in an address given a year ago, the world need in terms of conventional foods by 1970 should rise over existing demands by the following amounts:

Red Meats	7 billion lb
Dairy Products	622 million lb
Wheat	305 million bushels
Corn	443 million bushels
Food Fats and Oils	8.2 billion lb
Soybean Oil	4.6 billion lb

In addition, enormous amounts of poultry, fish, eggs, milled rice, barley, beans, and peas will be required. We should have a ready market for anything we produce - or at least the need will be there.

We can expect greatly-increased productivity and more efficient production. We are just entering the fertilizer age. In many areas where moisture is not a limiting factor summer fallow will be eliminated and high yields will be maintained under continuous cropping of all the land by means of heavy fertilizer use and chemical weed control. Certainly, a number of the more progressive farmers in Manitoba provide ample evidence of increased farm productivity and increased farm profit after ten years of continuous cropping.

By 1975 I expect that much of the wheat grown on the Prairies will be First Generation Hybrids. Research into the feasibility of producing hybrids in wheat started in 1962 and the evidence to date indicates that hybrid vigour in wheat is of the same order as hybrid vigour in corn and that a difficult but workable mechanism is available to make hybrid wheat possible. Considerably more research is necessary before the 25 per cent increase possible in hybrid wheats will become a reality, but with hybrid wheat production there should be a boom in a continuing seed business.

I predict that well before 1975 the Prairies will be growing a new food crop, currently known as Triticale. This is a synthesized species that combines the germ plasm of the durum wheats with rye and should have, with improvement, a productive potential about 50 per cent higher than that of the bread wheats. More than 2,500 acres were grown under contract this year in Manitoba to

provide large quantities of seed for animal feeding trials, baking trials, distillation, etc. The farmers growing the crop are more than enthusiastic about its potential.

The types of increases we can expect within a decade from the grain crops will be paralleled in livestock production. The speed of development and acceptance by farmers will be determined largely by public support in research and education, which brings me back for a moment to education. You have established an enviable reputation in education at the university level. Your scientists and scholars have provided leadership in many fields. Much of the success of agriculture in your province is a direct result of the research work of your Faculty of Agriculture. Abroad, your agricultural staff have made an even more impressive record. The names of Kirk, Hardy, and Harrington are almost legend with the Food and Agriculture Organization. But we need many more to replace them in the areas where the major work of increasing food production must be done. For even if, in the next three decades, we were to double our production of food in Canada, we are not and never can be the world's bread-basket. We simply do not have the land.

I have attempted to outline the problems and frightening challenges facing man in the decades ahead. I have suggested that if we mobilize man's resources at war time emergency levels to battle illiteracy and to provide food, mass famines could be averted. The responsibility is ours. In the words of Dr. B.R. Sen,

"One man's hunger and want is every man's hunger and want. One man's freedom from hunger and want is neither a true nor secure freedom until all men are free from hunger and want."

BUILDING

by

N. B. Hutcheon

Assistant Director

Division of Building Research

National Research Council, Ottawa, Canada

Man has always had a primary need for shelter, and has carried out construction for this purpose ever since he moved out of the caves. But buildings today have become much more than mere shelter, although they are still required primarily as protection from the outdoor environment. They represent a large part of the wealth of the nation and are intimately linked with our way of life. Since they are of unusual importance it is appropriate that they should be included as a topic for consideration in this Jubilee Symposium about a city and its future.

When one thinks of buildings, one may also think of the construction industry that produces them. It is Canada's largest. It has been said that "... Construction activity in Canada is completely interwoven with the social fabric of the economy In general the health of the construction industry is basic to the welfare and progress of the community and conversely the progress of the community is basic to the prosperity of the construction industry." When construction is viewed in these terms, and particularly that part of it which goes towards the provision of buildings, any prediction of the changes to be expected over the next 60 years may prove to be highly uncertain.

It will be necessary, if more than mere guesses are wanted, to take into account not only the possibilities for new technology but also the desires of society and the choices that will be made as to the disposition of the productive capacity of the country. There are, in addition, the two basic questions of what the population growth and the economic growth of the country are likely to be. All of this is difficult enough for the country as a whole, and becomes highly speculative indeed if regional and local differences are to be taken into account.

Consider the level of activity now devoted to the production of buildings. The total value of all construction in Canada for 1966 will be about \$11 billion. This accounts for about 20 per cent of the gross national product. This dollar value of construction reflecting as it does a high level of economic growth, will be 11 per cent over that for 1965. About 60 per cent of construction is taken up by buildings, the remaining 40 per cent by civil engineering construction (including roads and bridges, municipal services, and power and communication facilities). About half of the building, or 26 per cent of total construction, is required for housing. By comparison all industrial buildings account for only 8 per cent, commercial 10 per cent, and institutional 11 per cent. These figures are for Canada as a whole. The forecast totals for Saskatchewan in 1966 are \$622 million, which is 5.6 per cent of the national total, but the proportion for engineering construction is about 51 per cent, which is higher than the national figure of 40 per cent.

Construction is currently employing about 620,000 workers, or about 7 per cent of the labour force, with an annual total wage bill of \$3.5 billion. An additional \$5.4 billion worth of material, mainly made up of output from the manufacturing industry, is employed. It may be noted in passing that wages account directly for about 32 per cent of the total construction bill, while materials make up almost 50 per cent. This is of some significance when ways of reducing costs of building are discussed.

Two notable studies have already been made of Canada's economic prospects. The Royal Commission on this subject offered projections to 1980 in its Report published in 1957. More recently, in December 1964, the Economic Council of Canada issued its First Annual Review entitled "Economic Goals for Canada in 1970." Several of the ancillary studies from both these endeavours, particularly those on "Housing and Social Capital" and "The Canadian Construction Industry" for the Gordon Commission and "Housing Demand to 1970" prepared for the Economic Council provide some interesting projections.

The population of Canada is expected to be about 27 million by 1980 and the expenditure on construction will probably rise to \$14 or \$15 billion in terms of 1955 dollar values. Of special interest to University cities such as Saskatoon are the projections of University enrolment based on an increase from 6.7 per cent of the university-age

population in 1950 to 15 per cent by 1980, giving a University enrolment then of 267,000, or about double the number projected in the same study for 1965.

It can be taken for granted that the population of Canada will continue to increase. It trebled in the past 60 years and will probably double before the next 60 are over. In the same period the population of Saskatchewan rose almost tenfold. No comparable increase in the next 60 years for Saskatchewan or for its major cities need be expected, but an increase of threefold would seem to be quite possible. A doubling or trebling of the population means that, very roughly, the building requirements will also be doubled or trebled.

With regard to the kinds of buildings that will be required, where they will be located, and how they will be arranged, there is less basis for projections. More specific questions are required regarding what people will want or will do, because buildings are for the use of people, directly or indirectly, and will in general be built in accordance with the directives provided by society.

For example, the gradual shift from rural to urban living should be noted. In 1961 almost 70 per cent of the population of Canada could be found in urban centres and only 12 per cent directly on farms. One is tempted to suggest that there must be a minimum rural population required for food production and that this might provide a basis for predicting the rural population, but when one considers the trends of the past 20 years towards suburban living, the possibilities in mechanization and automation on the farms, and the fact that farmers may commute from cities and towns, one is left without a basis for a long-term prediction guess. The nature of these and other changes will greatly influence the kind and number of rural buildings required. The gradual disappearance of the rural school has already taken place, coupled with the development of larger schools in villages and towns to which pupils are transported daily for distances of 10 miles or more.

An equally dramatic change in urban living is represented by the present trend away from single-family houses to multiple dwellings. At the time of the 1961 census, about 65 per cent of all dwellings were single detached, Saskatchewan having 86 per cent and Quebec about 40 per cent. For several years new construction in the larger urban

centres has provided more dwelling units in apartments and other types of multiple dwellings than in single dwellings; and in 1965, for Canada as a whole, of the 153, 000 units completed 75, 000 or just under 50 per cent were single detached. In that same year, on the basis of construction started, there were 2500 more units in apartments than in single detached, indicating that the trend to apartment construction was still very active.

It is still too early to assess clearly what is happening in 1966. There are no obvious surpluses of new accommodation and it must be accepted that given the choices open to them in 1965 people have been prepared to occupy an increasing number of apartments as compared with single dwellings. There is no reason to assume that, given the same choices in 1966, the preferences will have changed suddenly or that the trend will not continue.

The shift to apartment construction has already had an effect on the construction industry. If continued for even a few more years at the present rate it will have serious implications for the general arrangement of cities. It is interesting also to note that this could represent a marked shift away from home ownership, since apartments mainly provide rental accommodation.

There are other factors, however, that can affect the choices open to people in the way of accommodation. It is well recognized that in some areas at least a shortage of serviced land has raised prices and has added to the cost of single dwellings. Apartments can be constructed on less land per dwelling unit and need not be affected by the cost of land to the same extent. There has also been a shortage of mortgage money to support dwelling construction. Single dwellings are promoted and financed in different ways from apartments, the former usually being constructed for sale to individual owners while the latter are held as commercial ventures on a rental basis. There is every possibility, with a change in the availability of money, that the two kinds of venture will be affected differently, thus altering the kind and relative cost of the accommodation offered.

It will be recognized that a city government can, through control of serviced land and perhaps also through tax policies or city zoning policies, affect the balance between single dwellings and apartments. It is also evident that Federal Government policies can affect

the availability of serviced land, the supply of mortgage money, interest rates and even the general climate for investment, which can significantly influence the supply situation as between single dwellings and apartments and thus the choices people may have open to them. Thus, having begun hopefully to find some basis for predicting the kinds of dwellings people may choose over the next 60 years, one is stopped short by uncertainty of what peoples' choices will be over even the next two or three years. It must be concluded, further, that choices can be affected significantly by the actions of governments.

Despite what has been said it is probable that the proportion of apartments to single dwellings will continue to increase for some time at least in many of the larger urban centres. It is interesting to note that already the recognition of this trend has produced further changes in the choices being offered. While apartment owners are publicizing special features such as balconies, sauna baths, swimming pools, gardens and recreation centres, some housebuilders are offering novel arrangements of housing units including single detached houses in integrated group designs providing recreational areas, swimming pools, landscaping and other special features in common.

It is impossible to avoid the conclusion that the automobile plays a large part in the choice of kind and location of housing as well as many other types of buildings. New single housing must be constructed for the most part on the less expensive land on the outskirts of cities. This introduces a transportation problem, which is usually resolved today by the use of private automobiles. One normally expects to find apartments in the centres of cities where it may not be necessary or desirable to have private automobiles, but apartments are currently being constructed in large numbers on the edges of cities, thus bringing ownership of an automobile into the choice of location in much the same way as for housing developments. The suitability of the automobile as transportation depends in turn on the traffic problems created.

Certainly automobiles are having a profound effect on our cities, promoting decentralization, freeing people from the need to live close to their work, and promoting the one-storey drive-in type of business or manufacturing establishment. All these things are matters of choice, greatly conditioned by the adequacy of the traffic facilities provided by streets, roads, parking areas and public transportation. These in turn are almost exclusively under the control of

municipal governments, either alone or jointly with their respective provincial governments. Thus, the physical form of our cities is inevitably influenced greatly by what governments do on behalf of the citizens of the community in dealing with transportation facilities.

Cities and the buildings in them can be influenced even more directly by building and zoning bylaws. Every city has a building bylaw that sets out the building code to be followed in the construction of all buildings. Such building codes are concerned primarily with the establishment of minimum levels of safety in respect of structure, fire, and health, but the building bylaws of which they are a part may go beyond these matters. Zoning regulations, which may be included in building bylaws or set out separately, are used to establish areas or zones within a city where particular kinds of enterprises will be prohibited. In this way the delineation of appropriate areas for residential, commercial, and industrial activities is achieved so that an orderly and broadly controlled development of the city can result, in accordance with municipal planning. Limits may be set on the maximum heights of buildings that can be constructed, on the size or floor area of building in relation to lot area, on the amount or proportion of private parking area that will be established, and on a variety of other matters. Such limits, prohibitions, and requirements may be varied appropriately for different areas of the city.

These kinds of regulations are essential instruments for the resolution and control of the conflicts that can arise between private and public interests and between the individual and the group in the use of land and the provision and use of buildings within the city limits. They may also be employed in positive ways to influence city development, but whether this is intended or not they inevitably become powerful factors in shaping the kind, form, and location of buildings within a city. Their implications may be so far-reaching that it is not always possible to predict at the time they are imposed just what their full effect will be.

Also to be recognized at this stage is the direct contribution to the buildings of a city represented by the construction of schools, hospitals, churches, libraries, city halls, and other municipal buildings, the nature of which can be influenced largely by the

community. We can recognize also the influence of the decisions made in the use, acquisition, and disposition of land by the city.

We see then that the nature of buildings in a city can be influenced in many ways by the city government acting through and on behalf of the citizens. These ways may be direct or indirect but are always under the control of the city. It seems inappropriate in this discussion of building to attempt to predict what the future changes in these factors will be. Let us return then, more hopefully, in our search for a basis for predicting future trends to a consideration of influences beyond the control of the people of a city themselves.

The most obvious and perhaps most intriguing possibility for change is the advance of technology. In an age that has brought television, high-speed flight and travel in space one assumes, naturally, that dramatic changes are also possible in buildings. The technology is already available to provide almost anything, within limits, that one could want, provided always that objectives are framed in sufficiently broad terms so as not to limit too drastically the possibility of finding ways of accomplishing the desired end result. The things that are impossible are those so narrowly conceived or circumscribed that no way can be found within the content of nature's laws by which they can be accomplished. It is almost a paradox that many small and apparently simple things may turn out to be difficult or impossible. We expect shortly to see men fly to the moon but we cannot and never will be able to support the Empire State Building on top of an egg. We can build a skyscraper 100 storeys high but we have not yet found a good general-purpose sealant with which to caulk the joints in its walls.

The listing of what is possible in innovations in building can be an entertaining exercise but gives little indication of the changes that are likely to occur, unless one considers at the same time the actual cost and the acceptable cost. Let us turn for an example to the question of tall buildings. It is now the skyscraper era in Canada, with 25- to 50-storey buildings being constructed across the country. Technically there is no fixed limit to going considerably higher, for the necessary technology was established more than 35 years ago. Many of the technical problems increase in difficulty with increasing height, but the real determinant is an economic one since the increasing cost

per square foot of floor space must be weighed against the higher rents that will be paid because of the prestige value. While the number of taller buildings will probably increase, it is very unlikely that any large proportion of the commercial space in a city will be provided in this way in the next few decades.

The use of glass in the exterior walls of modern buildings is another example. A strong trend toward the provision of a large proportion of glass was forced by a marked subjective preference that developed. There are serious technical and economic consequences of this trend which, it must be admitted, were not fully or generally appreciated until after the practice was well established. Some of the associated problems of visual and thermal discomfort and the increased cost of air-conditioning are now being partially relieved by further advances in technology. The preference, though now somewhat moderated, still exists despite the very substantial increases in building costs usually involved.

It may be seen, that the significance of the new technological possibilities must be judged in terms of the technical or functional advantage they offer, the extent of the subjective preference that can be developed in their favour, and their cost. These are also the essential elements in many kinds of business ventures. They are often difficult to assess or predict in advance and may be measurable only in terms of the ultimate success of the venture. Despite this difficulty of assessment, which faces every manufacturer of building materials and components, it may be possible to identify some possibilities for change.

We can expect a general steady improvement in almost all aspects of building technology, in the properties of the materials and components offered by manufacturers, and in the ability to design both broadly for the building as a whole as well as for the various specialist fields. There will be marked improvements in the ability to assess and predict the performance of materials and components, and of the building as a whole, as well as to communicate such information to those who have need of it.

We can expect that more effort will be directed toward achieving less costly buildings through increased consideration at the design stage of the problems of the contractor. On the contractor's

side we can expect an increase in mechanization on-site and better planning of work.

There will be increasing requirements for improved knowledge about various aspects of building, if only because of the new problems that will arise as changes are introduced. There will be a need for better education and training of the people involved at various levels of the construction industry as a whole.

We may expect shifts in the competitive positions of various kinds of materials, components, and techniques as conditions change. Economic considerations, particularly those based on initial cost, will be a dominant factor in promoting changes, but increased attention will be paid to the economic implications of maintenance and operating costs as well.

All of the activities that go toward the provision of buildings will have to be expanded to accommodate the needs for increase. At the same time, improvement in our standard of living is possible only if we produce more per man, or, in other words, if we reduce costs. Thus there will be need both for increased production and increased productivity in the building industry. These are already urgent matters in many countries of the world. Much attention is being directed in the first instance to the possibilities of reducing the proportion of labour used on the building site through increased prefabrication in factories, or in short, increased industrialization of building.

A parallel has been drawn, sometimes inappropriately, between the mass production of automobiles and the construction of buildings. Buildings because of size and weight will always be assembled on-site. No two buildings are identical, if only because of variations in foundation and other site conditions. Most of the materials used in buildings today are already mass produced elsewhere and transported to the site for erection. Any extension of industrialization must mean, therefore, the manufacture of larger and larger pieces in factories.

None of this is new in principle. Large steel components have long been shop-fabricated, and there has been a great increase in the last few years in the provision of large building elements made of reinforced or prestressed concrete. Much of the mechanical equipment for buildings is now provided in packaged units, and has always represented a high degree of prefabrication.

If this trend is to be accelerated a number of associated developments will be necessary. Increased standardization in design, manufacture, and construction will be necessary to reduce the number of different sizes of components and thus increase the number of identical units that can be made and sold. Some standardization may have to be introduced into building plans.

Progress toward increased industrialization has already been carried quite far in Scandinavia and Finland, in Great Britain and on the Continent. There is much experimentation, and many building systems are being developed and used. Much of this work is based extensively on the use of concrete for structural elements and for floor, wall, and roof panels. There are those who look forward to the day when it will be possible to select from catalogues all the parts necessary to construct a building.

Although there is no doubt that industrialization can reduce the labour required on the construction site, it is not yet clear whether an over-all increase in productivity, and therefore a real cost reduction, can be effected. Governments in some countries are, for various reasons, actively promoting industrialization of building, but it is probable that a very considerable shift toward it will occur naturally under conditions in Canada. We may take for granted the fact that materials and techniques requiring a large proportion of hand labour on site will gradually be replaced. Unit masonry, for example, will be challenged increasingly by precast concrete and other kinds of factory-made panels.

Changes can be expected in the design of buildings to effect reductions in the labour and other costs involved in the maintenance and operation of buildings as well as in their construction. We may expect to see increased mechanization in such operations as building and window cleaning. The automatic operation of building heating and cooling systems and the associated equipment will be extended. Electronic devices like small computers will be employed increasingly in monitoring and control operations. The selection of finishes, coverings, and claddings will also be influenced.

We may expect improvements in the properties of the steel and concrete from which the main structural parts of our buildings will continue to be made. Even greater improvements can be expected in the forms the components will take to achieve the necessary performance at the lowest costs. Wood, though still used extensively as a natural product,

already appears in a number of more highly refined forms as laminated structural members and as plywood and chipboard. In the form of paper it is widely used in a variety of surfacing materials, and is often combined in one form or another with other materials in the manufacture of various kinds of sheets and panels.

Much may be expected of plastics, since there is an almost unlimited possibility of developing new substances having a variety of different properties. Manufactured products, resulting from complex chemical processes, will always be relatively costly on a per pound basis compared with many of the common building materials. They do not offer good properties for structural uses by themselves and for this reason, in addition to their cost, they are unlikely to provide a serious challenge for major structural applications. They will continue to be used, increasingly, where unusual or special results can be obtained with relatively small amounts of material at costs that are acceptable. Such applications involve their use as adhesives, sealants, insulating materials, coatings of all kinds, as floor and wall coverings, and as small components in which appearance and form are important.

Plastics can be used in structural forms in which high performance can be obtained with relatively small weights of material. They can be more readily used in combination with other materials to form the cores of light, high-performance panels and other elements providing structural and other capabilities.

This trend toward the development of higher performance building elements using smaller quantities of new and improved materials in better ways can be expected to continue. The advantages, however, may have to be weighed against such disadvantages as the increased deflections, vibrations, fire and smoke hazards that may result from materials that are combustible, and the increase in sound transmission and loss of fire resistance when lighter components are used for walls and floors separating occupancies. Much of the major and hidden structural parts of buildings will continue to be made of steel and concrete, but the cladding will be provided by a great variety of materials in the form of thin sheets or panels that can be varied as desired in colour, texture and other properties.

The form of cities and the nature and distribution of the buildings in them can be and will continue to be greatly influenced, though

indirectly, by government actions in respect of monetary and housing policies and by urban transportation. Strong and more direct influences can be exerted as desired through regulations in the form of municipal bylaws covering the use of land and the design of buildings.

Within this framework of influences the development of buildings is further strongly conditioned by the choices of people, through which economic and other incentives are brought to bear. Technological advances serve only to increase the range of possibilities. In the end it is people and their preferences that will largely determine the nature of the buildings of the future.