A DEVELOPMENT PLAN
FOR PUERTO RICO

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The contents of this publication are the sole responsibility of the authors, and do not necessarily bear the endorsement of the Puerto Rico Planning, Urbanizing, and Zoning Board.
HONORABLE REXFORD GUY TUGWELL,
Governor of Puerto Rico,
La Fortaleza, San Juan, Puerto Rico.

DEAR GOVERNOR TUGWELL: I have the honor to submit herewith A Development Plan for Puerto Rico, published as a Technical Paper of this Board. The Puerto Rico Planning, Urbanizing, and Zoning Board has worked with the Caribbean Field Office of the National Resources Planning Board during the past year, during which time the preparation of a Development Plan for Puerto Rico has been the chief activity of that office.

When the National Resources Planning Board was abolished by act of Congress, copies of the Development Plan as prepared by Mr. Frederic P. Bartlett and a staff consisting of Louis Sturcke, Jr., Donald F. Griffin, and Brandon Howell were made available to this Board as a working paper. Since the National Resources Planning Board decided not to publish this plan, the Puerto Rico Planning Board, in consideration of the importance attached to the report, is issuing it in this form as a staff paper on the sole responsibility of the authors. We wish to express our appreciation to the National Resources Planning Board for releasing the report to us, and to the Office of Information for Puerto Rico for financing its publication.

The Development Plan has been a cooperative effort, but like all such efforts there will always be certain details on which different opinions may be held. The basic outline of the plan is sound, and its clear presentation of material should prove useful both to government agencies and to private persons interested in the full development of the Island’s resources.

Sincerely yours,

RAFAEL PICÓ,
Chairman.
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During the fiscal year 1942-43 the staff of the Field Office of the National Resources Planning Board, with the help and cooperation of the Puerto Rico Planning Board, prepared a draft of A Development Plan for Puerto Rico. When the National Resources Planning Board was abolished by Act of Congress, the material contained in the report was made available to the Puerto Rico Planning Board, since it was largely through their aid that the final draft of this report was made possible.

It should be recognized that, in the usual sense of the word, Puerto Rico cannot be considered to constitute by itself a regional area. In this respect it is quite different from other major regions which have been used in the United States as a basis for study. But the Caribbean area, however its exact limits may be defined, is one of the acknowledged regions of the world. Geographic, climatic, historical, and economic studies of the Caribbean region have recognized this. As regards the Islands of the Caribbean for example, it is evident that the development of practically all of them has been influenced by the need for cheap labor for their sugar economy. This has resulted in an increasing pressure of people against resources and a general low standard of living.

Thus, although this plan is concerned only with Puerto Rico, no assumption is implied by this approach that Puerto Rico may not eventually become in certain economic respects more closely integrated within the Caribbean region. For it is certainly conceivable that the conditions of peace will require larger and more stable economic associations. It is hoped that in future studies Puerto Rico may be considered more adequately in relation to its neighboring Caribbean islands.

This plan has been based on the assumption that the resources of Puerto Rico should be developed and utilized in such a way as to benefit primarily its residents, regardless of existing or future economic self-interests of the continental United States.

The plan is a guide post, not a blueprint. Translating it into definite programs and finally into accomplished facts will depend upon its validity and acceptance by the community and its leaders. It is flexible in order to meet changing conditions and changing needs in a fast moving world. It is in itself an indication of an awareness by all concerned that all resources must be developed harmoniously in relation to each other—not independently and with inevitable waste. That all the projects suggested herein will be financed in whole or in part by the Federal Government should not be inferred. Undoubtedly some will fall into the category of Federal projects and others as projects to be undertaken by the Insular Government; still others might well be undertaken by the municipalities themselves or even by private interests. The plan itself should serve as a basis for evaluating the merits of specific projects by any group proposing to undertake them.

Much of the material in the Plan was gleaned from reports and plans prepared by Insular, Federal, and local agencies. Valuable data and information were also received through conference groups and by letters from individual's intimately familiar with the Island's problems and possibilities who reviewed critically the preliminary drafts. The objectives and recommendations for action, in other words, have taken into account the recommendations of many agencies, organizations and individual's. Appreciation is here gratefully acknowledged for the advice and assistance that has so generously been given by these many persons and agencies. We have attempted to correlate the many suggestions received so that the plan might offer a program for developing the Island's resources in a way most nearly acceptable to the people of Puerto Rico.

Frederic P. Bartlett.
PUERTO RICO—A SUMMARY OF GENERAL INFORMATION

Historical Background

1493—November 19. Puerto Rico discovered by Christopher Columbus on his second voyage and given the name of San Juan Bautista. The discoverer brought with him on this trip the crop which was to have such an influence in the West Indies—sugar cane.

1508—Juan Ponce de León landed at the bay of Guánica, later founded city of Caparra on San Juan Bay. Capital city officially transferred to present site in 1521.

1518—Slavery introduced into the Antilles.

1528—First of many attacks by foreign corsairs—the French attacked and destroyed the town of San Germán. For two and three-quarter centuries English, Dutch, and French raided the Island but never held it or any of its towns except in 1598.

1533—The first fort, now part of the Governor's residence of La Fortaleza, begun.

1570—Gold mines exhausted, having produced in value about 4 million dollars.

1595—Sir Francis Drake and Sir John Hawkins driven off, the latter meeting his death in the attack.

1598—The English landed and held San Juan for 5 months.

1765—First island-wide census taken; population 44,883.

1808—Representation in the Spanish Cortes granted Puerto Rico. Puerto Rico given this privilege only at varying periods thereafter.

1823—Several local “disturbances” or conspiracies reflecting somewhat feebly the struggle going on through the nineteenth century between the forces of reaction and liberalism. Even the LARES “Rebellion,” 1868, has been subject to this interpretation.

1866—Puerto Rican delegation journeyed to Madrid to petition for reforms in the Antilles and for civil rights and abolition of Negro slavery in Puerto Rico.

1873—Slavery abolished.

1898—February 9, by Royal Decree autonomous government inaugurated in Puerto Rico. October 18, United States troops occupied San Juan. December 10, Puerto Rico ceded to United States by Spain, after more than 400 years of Spanish rule.

Size

One hundred miles long by thirty-five miles wide. Land area, 3,423 square miles.

Topography

Low, narrow alluvial coastal plains almost continuously encircle the Island. Mountainous interior forms definite east-west cordillera extending across the island and rising at the highest point to 4,398 feet above sea level.

Population

1899—953,243 (year of first census after the American occupation).

1940—1,869,255.

Climate

Trade-wind climate prevails without extremes in temperature. Average yearly rainfall is 70 inches with no well-defined island-wide dry season. South coast is considerably drier than north coast. Showers generally last but a few minutes, followed by brilliant, warm sunshine. The climate is mild the year around. Average winter temperature is 76° F. and in summer the temperature averages 80° F. In the 116-year period from 1825 to 1941, 22 tropical cyclones or hurricanes have caused severe destruction of property on the Island.
Industry and Trade

The Island's industries and trade have been based on:

Export cash crops and their processing, for instance:

- Raw sugar, refined sugar, rum, industrial alcohol, and molasses.
- Stripped tobacco, cigars, and cigarettes.
- Fruits and fruit products.
- Vegetables and vegetable products.
- Coconuts and coconut products.
- Coffee.
- Sea Island cotton.

Availability of skilled hand workers, which has encouraged:

- Needlework and textile manufactures.
- Shell button making.
- Jewel cutting for precision instruments.
- Usual small industries for local consumption, such as:
  - Beverages and foods.
  - Printing.

Except for two-thirds of its food by weight and one half by retail value, and except for a small quantity of locally made goods, Puerto Rico imports from the United States either in unprocessed or finished form practically all that it consumes.
SUMMARY OF THE DEVELOPMENT PLAN

The Problem

A tropical, mountainous island about two-thirds the size of Connecticut with a population of 2,000,000 people. Three main forces—increasing population (30,000 a year), inadequate income production (perhaps $800 per family of 5 persons), unsatisfactory income distribution (300,000 out of Puerto Rico's 350,000 families receive an average of $341 a year)—have resulted in a vicious circle of population maladjustment. The basic causes are economic, evident in the ubiquity of poverty; the contributing causes are discouragement and apathy. Uncertain political status constitutes a complicating element.

The Goal

A minimum standard of living for every Puerto Rican family, with the health, education, and social outlook adequate to permit the enjoyment of this standard.

The Plan

Only four general approaches are possible to attain this goal:

1. To receive more assistance from outside. This is rejected.
2. To develop the Island’s resources and expand its production to the greatest possible extent, even with protection or subsidies. This is the basic approach outlined below:

A. Resources Other Than the People

Agriculture and processing of its products.—The island must intensify land uses, increase productivity by better methods, stabilize land tenure, develop new crops. This will require more irrigation, better water utilization. Sugarcane should be the main crop as long as possible, but livestock, cotton, soybean, coconuts, and specialty crops can be developed. Great expansion in utilization byproducts of sugar is possible through manufacture of refined sugar, candy, fiberboard, and other items, and above all, edible yeast. Coconuts should be more fully utilized. Processing of local cotton is possible.

Forestry and processing of its products.—Forest areas should be utilized more intensively with more emphasis on quick-growing timber for charcoal, stakes, crates, etc. There is enough lumber for the island’s local furniture needs, if production costs are disregarded. The Island should improve charcoal techniques and utilize mangroves for tannin.

Mining and processing.—Silica sand, limestone, and clay are commercially exploitable, manganese and iron ore possibly exploitable. The glass industry is being initiated, and a ceramic industry is desirable.

Fisheries and fish products.—There are no rich local fishing grounds, but some expansion of fishing is possible and desirable. Fresh-water fish ponds should be encouraged.

Industries based on imported raw materials, principally for local consumption. Vegetable fats can be made from imported copra, ordinary cotton goods from imported short-staple cotton.

Tourist attractions, both cultural and physical. Some development is needed, but the industry will remain relatively unimportant as a source of income.

B. Facilities

Water power can be tripled.

Transportation.—The basic highway network is adequate, but improvement of circumferential and two trans-island highways to meet modern standards are desirable. Airway facilities are inadequate. Railways should be maintained for freight and emergencies. Shipping facilities should be improved.

C. The People as a Resource

The people are, of course, as important to production as good land, water, and power. Strong, healthy, intelligent people are necessary for full production.

Health, sanitation, and domestic water in Puerto Rico are all very closely associated, but no plan for the gradual reduction in the now excessively high non-degenerative diseases is available. A planned program for sewer and water improvements is presented.

Education.—Even to provide at least 6 years of elementary education for every child would require an 80 percent increase in the present budget. Reorientation in the quality of teaching is as important as provision for more schools.

Housing and community development offer not only a vast field for increasing human efficiency, but also a reservoir of badly needed public works. Eighty-three percent of all houses in Puerto Rico are valued at under $300 or rent for under $10 a month.

* Subject to correction. See section on Income Distribution.
Government.—Standards of public administration need improvement and United States-Insular administrative and fiscal relationships need simplification. Police can improve operations; fire protection is not adequate. Both will become more necessary as Puerto Rico becomes more urban and more industrialized.

3. To adjust resources and people. This may be accomplished by emigration, education, and birth control, but particularly by the latter two, so that increasing standards of living may become effective in gradually correcting the disequilibrium between people and resources.

4. To redistribute existing income. Although certain estimated data are presented, they are far too tentative to warrant any judgment of this fourth and last approach to the problem of Puerto Rico.
Puerto Rico has, on occasion, been referred to as the Gibraltar of the Caribbean. Whether or not the geopolitical analogy is overdrawn, it indicates that the Island has intrinsic military value quite aside from all other considerations. Such strategic value as it possesses might be enjoyed by the United States without having to assume responsibility for the non-military affairs of Puerto Rico; this has long been the case in Guantánamo, Cuba, and is now the case in all the bases leased from the British. However, in any island the size of Puerto Rico, military requirements must necessarily impinge upon the economic, social, and political life to an extent that will demand particular adjustments.

It is now evident that planners in the past have perhaps not been as fully conscious of military needs as they should have been. The war itself has changed not only the direction, but also the tempo and intensity, of planning. Perhaps the most striking reflection of this fact is the increasingly accepted postulate that we cannot fight a total war without total planning. The need to plan now for the fullest and most efficient development and utilization of all resources for the benefit of all the people in time of peace is as important in the development of Insular resources for local benefit, as it is for the development of continental resources for larger groups.

This plan is directed toward the use of the Island’s resources to help win the present war, and toward their use for greater prosperity and well-being of the Island after the war. What we do now to win the war may determine our future economy. For instance, it is certain that the effect of wartime shipping will carry over into the post-war period, that wartime aviation developments will greatly expedite civilian post-war aviation, that ideas and standards acquired by Puerto Rico’s citizen soldiers will carry over into demands for post-war goods and services progressively different from those acceptable before the war. In one important respect, however, the war’s effect on Puerto Rico has been quite different from that in most other sections of the United States: the war has brought no large-scale war industries to Puerto Rico. Because of its exposed geographical position, its status as a “theater of military operations,” the difficulty of shipping materials for fabrication, and the previous existence of only a few industries on the Island, it was unlikely that war would bring many industries to Puerto Rico.

The war, however, may have one important indirect influence on the industrialization of the Island. In order to reduce the amount of inbound shipping, the development of industries which use local raw materials such as glass making should be and is being encouraged. War may also make it imperative that Puerto Rico expand its own local production of foodstuffs; every ton of food produced locally which can replace a ton of imported commodities saves just that much shipping space vitally needed for our offensive against the Axis. It has often been noted that Puerto Rico before 1941 was becoming increasingly tied by export and import trade to the mainland and therefore becoming less and less self-sufficient. War may reverse this trend, and its repercussions on post-war planning for the Island’s economy may be far-reaching. For with decreased imports, some agricultural land will of necessity have to be devoted to low cash-value, but high life-value food crops instead of high-value export cash crops.

War has also imposed upon the Island the duty of being host to the armed forces. Its recreational and commercial services and facilities must be expanded to care for the influx of the Army and Navy personnel. Its ports, highways, and other public facilities must be enabled to handle specialized peak demands. These problems are of course not so acute as those facing small continental communities where war industries have suddenly mushroomed, for in potential military operation areas the Army and Navy themselves provide a great part of the goods, services, and facilities needed for their own personnel. They develop their own recreational facilities, provide much of their own light, power, and water, and build their own terminal improvements. However, the Island’s civilian communities have necessarily had to accommodate their facilities to increased and specialized military needs. Public roads must bear the wear of heavy-duty motorized equipment; community services are used by military personnel on leave. It is obvious, therefore, that any long-range plans to improve general health conditions and to provide recreational facilities for the permanent population would fit into a desirable shorter-range program for immediate war-time needs, for a healthful environment is a desirable asset to a fighting army. Similarly, local improvements of such public facilities as highways, water supplies, and power developments will help the Island’s contribution to active military operations.

Influence of the War on Long-Term Planning

In two respects, future trends of war-induced activities are of vital importance in long-term planning.
These are: (1) the trend of military construction—airfields, cantonments, naval bases—in the Island and
(2) the trend of induction of Puerto Ricans into the armed services. They affect, in a very real degree, the
economy of the Island. As long as construction and inductions into the armed services are increasing, the
United States through Federal expenditures is increasing or maintaining the monetary income of Puerto
Rico. This is perhaps most clearly realized when it is considered that the Puerto Rican private, like every
other private in foreign service in the Army of the United States, receives at least $720 a year, plus food,
clothing, lodging, and compensation for dependency, while the estimated average annual earnings per family
among wage earners in Puerto Rico is only $341.\(^1\) Decrease in military construction during the war and the
inevitable demobilization of men after the war will reduce the Island’s income and, by necessitating counter-
actions to relieve this effect, will influence the programming of any development pattern. The present plan,
in effect, assumes a continued decrease in war-time military construction, but some counterbalancing increase
in inductions. This, together with other wartime factors causing increased unemployment, such as the shipping
shortage, suggests that certain phases of what might otherwise be post-war public works be brought forward
into the present wartime economic emergency which faces Puerto Rico.

On one hand, the possibility of utilizing for post-war civilian use wartime improvements which have been
made or will be made should be considered. Specifically these include: new or improved highways; air-
fields; Army and Navy recreational areas; and excess water, power, and hospital facilities which will not be
required by peacetime garrisons. On the other hand, military requirements have taken about 25,000 acres of
agricultural land out of production in Puerto Rico for military bases, airfields, and road construction. This
is a serious problem in a land-hungry country, for alternative employment cannot easily be found for the
families thus dispossessed.

\(^1\) Work Projects Administration and Insular Department of Labor, *Survey of Incomes and Expenditures of Wage Earners, Puerto Rico, 1942.*
PLANNING FOR THE FUTURE—PROBLEMS AND GOALS

The war has brought and will continue to bring special problems as well as some economic opportunities to Puerto Rico; but it cannot change the basic, underlying problems of the Island. The realization of just what these problems are and the prescription of sound remedies for them must be matters of first importance to Federal and Insular legislators, executives, and private citizens who are concerned with the welfare of the island of Puerto Rico. For no planning, irrespective of its merit, is of much real value unless it is developed in cooperation with, and accepted by, those in a position to put plans into effect. The existence of a trained Insular planning agency such as the Puerto Rico Planning Board is an imperative aid not only to the making of new plans and to the improving of old, but also as an educational force, supplementing the more formal educational work of the school system.

The Problem of Puerto Rico

The "problem" of Puerto Rico has been outlined many times before.1 Basically, of course, the problem arises from an increasing growth in population with no land frontier to push forward and an insufficiently rapid increase in productivity. Puerto Rico is an island 1,000 miles removed from the continental country of which it forms both an economic and political part. It possesses few mineral resources of commercial importance, and its available land for cultivation is limited to 1,000,000 acres. Yet its population has twice doubled in the last 100 years and at present shows no tendency whatsoever to taper off.2 Indeed it is increasing at a net rate of more than 30,000 a year. On the basis of medium assumptions, developed by Thompson and Whelpton's empirical method, estimates indicate that the population will continue to increase at its present rate until at least 1960, when it will reach almost 2,900,000. Within only 20 years Puerto Rico will have another 1,000,000 people to feed—and it cannot adequately feed its present 1,900,000. By 1960 there will be in Puerto Rico 3 persons for every acre of arable land. These facts mean that the pressure of population on resources, which is already great, will become intolerably greater.3

High Birth Rate

High birth rates are often associated with low living standards, as though peoples who live precariously close to starvation multiply more rapidly than others to assure their group existence. Puerto Rico's birth rate in 1941 was 39.8 per thousand. Only 3 independent countries of the Caribbean had higher rates at the time of their last official estimates: Costa Rica with 42.3 births per 1,000 population; El Salvador with 41.8; and Guatemala with 41.2. At the other end of the scale Cuba had 16.7, Panama 26.7, and Nicaragua 27.4—all more than 10 points lower than Puerto Rico.4 In Puerto Rico in 1935 there were 912 children under 5 years for every thousand women between the ages of 20 and 44. This is 44.1 percent higher than in the South Atlantic States, where there were 633, and 87.6 percent higher than in the entire United States where there were only 456 per thousand in 1930.

Low Death Rate

The other factor making for a high level of population growth is Puerto Rico's relatively low death rate.5 In 1940 it was 18.4 compared to 10.8 for continental United States. In view of the great difference in living standards between the Continent and Puerto Rico, this difference is rather remarkable, a tribute to the public health work of both Federal and Insular agencies. It has been suggested, indeed, that such measures, by "artificially" affecting the death rate, have helped to overthrow some previously existing biological balance. The implication in this belief, i. e., that public policy should not try to prolong human life, is untenable. But the facts do not particularly confirm the

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2See figure 1.
3See figures 2 and 3.
4Incidentally Cuba's birth rate of 16.7 as reported by the U. S. Bureau of the Census from the latest official Cuban sources is even lower than that for the United States (17.3) and only a little above England's 16.5. That Cuba in 1939 should have had approximately the same birth rate as the United States and England is so surprising that it may cast doubt on other demographic data from areas where vital statistics are not above question. Cf. Forrest E. Linder, Population and Population Statistics of the Caribbean Area, U. S. Bureau of the Census, Washington, 1941.
5Although the weighted death rate for all Spanish-speaking countries comprising the Caribbean as most recently reported was 16.0, the possible error to which all demographic data for Caribbean countries are subject should be recalled. (Linder, op. cit.) It seems hardly conceivable, for example, that the Dominican Republic's death rate was only .2 in 1939.
assumption. During the period 1887–97, the Island’s population increased at a rate of about 1.4 percent per year; from 1930 to 1940, at 1.8 percent.

Production and Population

Has productivity kept up with, advanced beyond, or fallen behind the increase in population over the last 30 years? This is a difficult question to answer because early figures for Puerto Rico are probably unreliable and recent data are inadequate. Census information, which presumably is the most reliable, shows a rather confused picture. Between 1910 and 1940 population increased by 67.2 percent, while certain indices of production or income increased more and others less.

A cursory study of these figures would seem to reveal that productivity in general has kept well in advance of population in Puerto Rico, as it has throughout most of the industrial world. Indeed, the data almost appear to demonstrate that the Island’s production has doubled in per capita terms since 1910, and to support the relatively large total income figures estimated in the income distribution section of this plan. But, of course, even census data may be incorrect; certainly, they are incomplete. The other side of the medallion is the one which has had more attention; that is, the per capita income of lower income families as distinct from the total income just analyzed. The Puerto Rico Reconstruction Administration in 1936 and 1937 studied the incomes of 745 families living in the sugar cane area and of 5,743 families living in the tobacco, coffee, and fruit regions. The average annual income both in cash and in kind was found to be $255 and $171 per family in these 2 groups of regions respectively. In a more recent study of 2,000 families scattered throughout Puerto
Rico, the Work Projects Administration has estimated that the average annual income is $341.8 This figure is the one usually accepted as best measuring prevailing living standards.

### Percentage change 1910-40

**I. These factors increased more than the increase in population:**
- Sugar cane production .................................................. 187.5
- Tobacco production ....................................................... 83.8
- Cotton production ......................................................... 166.3
- Production of all other field crops .................................. 493.0
- Gainfully employed in manufacturing and mechanical industries .................................................. 149.4
- Gainfully employed in transportation ................................ 108.0
- Gainfully employed in professional services ......................... 208.9
- Gainfully employed in clerical occupations .......................... 586.1
- Total value of exports .................................................... 188.0
- Salaries and wages in industry ......................................... 158.8
- Value added by manufacture ............................................. 191.1

**II. These factors increased, but less than population:**
- Gainfully employed in agriculture ..................................... 3.3
- Persons engaged in industries ........................................... 47.4
- Gainfully employed in trade ............................................. 49.9
- Total gainful workers ..................................................... 312.6

**III. These factors actually decreased:**
- Coffee production ......................................................... 38.1
- Cattle and calves ......................................................... 4.5
- Gainfully employed in domestic and personal service .............. 20.3

*Based on 1910 and 1925 population census data, since comparable classifications for 1940 are not available. In 1935, 622,825 persons 10 years of age and over were reported gainfully occupied, in comparison with 640,841 persons of this age group reported in 1940 as employed or engaged in public emergency work. Hence 1940 figures would presumably be in general 2.3 percent higher than those given for 1935.

Conclusions

Whatever the comparative importance of a high birth rate, a relatively low death rate, and an apparent generally low income level, it is clear that (1) the increases in production cited above have not been sufficient to raise general living standards to a point where the latter can have any appreciable effect on the birth rate or size of families and that (2) the end product is, or has been until recently, a state of discouragement and apathy. These are final causes and results of the vital problem which now faces Puerto Rico. To feel a sense of social responsibility a man needs to feel himself a useful and productive part of the community; if there is no such feeling, there can exist no conscious or unconscious desire to bring only those children into the community who can contribute to it and be adequately supported by it.

In summary terms, the "problem" of Puerto Rico seems based on three interacting factors which form a vicious circle of cause and effect. These factors are: poverty, discouragement, and increasing population.

*Work Projects Administration and Insular Department of Labor, Survey of Income and Expenditures, San Juan, P. R., 1942-43.*

**Political Status**

Most responsible elements interested in Puerto Rico’s development, and above all the Puerto Ricans themselves, apparently want to see Puerto Rico as independent and as responsible for its own future as it can possibly become. It has been held in Puerto Rico, however, that the Island has never had either the responsibility or the authority to care for itself. Under both Spanish and American sovereignty it has had limited powers of self-government, and under the latter has not been able to elect representatives to the national government which makes decisions affecting the welfare of the island.12 At least until recently, there has appeared to be less feeling of responsibility for its own destiny and more feeling of reliance upon outside help than in the independent countries of the Caribbean. Puerto Rico has also always been closely tied with its mother country, although much more closely since 1898. These close relationships have carried different responsibilities and different authorities, which in turn have influenced the Island’s basic economy. To understand the latter, therefore, a study of the Island’s political status is important.

The relationship between one community and another is influenced by ethics, altruism, and self-interest of their respective peoples. Each of these has played its part in determining the present status of Puerto Rico and will ultimately determine any evolution in them. It becomes necessary, therefore, to analyze briefly these factors as they affect various types of policy for the island.

The United States took Puerto Rico from Spain in 1898 by force of arms. In its occupation 5 Americans lost their lives and 17 defenders of the Island perished. Since then, for 45 years, Puerto Rico has been under the sovereignty of the United States, but has not been an incorporated territory like Hawaii and Alaska. The reasons why Puerto Rico was treated differently from Cuba in the Treaty of Paris are not entirely clear; it was perhaps due to the lack of any unified opinion in the Island regarding its future status and to the general outlook 12 At certain periods under the Spanish regime, Puerto Rico was permitted to elect representatives to the Spanish Cortes. See Historical Background, p. 1.
of the United States itself at that time. In any event, the status established for Puerto Rico did not permit Puerto Ricans to participate in the determination of national decisions which would vitally affect them, such as tariffs, coastwise shipping, labor laws, and agricultural policy, although under the Organic Act the Island secured considerable independence in the management of its own affairs and the United States was careful not to tax Puerto Rico for any Federal purposes and even returned to it excise taxes collected from continental consumers of Puerto Rican goods sold in the States. The United States, however, has never faced the question of whether Puerto Rico's present status should be changed, to say nothing of the decision as to how it should be changed. The latter is more difficult because it involves the problem of respective benefits to be secured by the United States and Puerto Rico from the resolution of the problem of status.

Today this uncertain status makes it almost impossible to plan for Puerto Rico. One is faced with the necessity of first answering these questions: Does the United States "owe" Puerto Rico more or less than it "owes" any individual State? Does it owe it more or less than any "independent" country in the Caribbean or Central America? Or does it owe Puerto Rico anything?

In the last case, there is no need for the United States to plan for the Island. If the United States, however, does accept some responsibility toward the Island, as would be implied at least on abstract ethical grounds by the fact of its having taken over the Island by force, then it would appear desirable to define the limits of that responsibility. Does it extend to: Providing assistance on a basis comparable to that for a State? Providing only the type of assistance associated with the "good neighbor" policy? Providing some sort of special help? For whether Puerto Rico's future is determined by the United States or by Puerto Rico or by both together, the final decision will be completely dependent upon the answer given to these questions.

Independence

If the United States thought only of itself, it might best offer the Island independence and provide only that assistance which it gives other "good neighbors," perhaps including compensation for military bases. For with Puerto Rico as independent as Cuba, for example, the United States would be able to maintain military bases on the Island with attendant policing precautions to prevent its being used as a focus for fifth-column activities by any enemy of the United States, without being responsible for its standard of living. Independence would mean a reduction in Federal aids of one kind or another and would permit the exclusion of Puerto Rican sugar from the United States free market, except insofar as the United States might consider it wise to give Puerto Rico a preferential duty in return for a market for its own exports. Excise taxes on Puerto Rican rum paid by United States consumers would remain in the United States. It is hard to estimate the net economic effect of such independence for Puerto Rico for there are many intangibles which cannot be strictly evaluated, such as the stimulus to enterprise which responsibility for one's own destiny encourages. But from the United States' point of view independence would mean:

1. Elimination of annual Federal grants-in-aid and of direct Federal expenditures on behalf of Puerto Rico for work relief, public works, free commodity distribution, and so forth (but excluding military expenditures except for the Veterans Administration) amounting in all to perhaps $39,500,000 a year.

2. Retention of customs and excise taxes on imports from or through Puerto Rico to the United States, amounting to approximately $14,000,000 a year.\footnote{In normal years.}

3. Elimination of sugar and agricultural conservation payments amounting to about $10,000,000.

4. Probably an even balance of trade, the United States buying sugar and selling food and manufactured goods under reciprocal trade agreements.

5. No responsibility for Puerto Rico's economy, regardless of the possible reactions of all Latin America.

In other words, the United States would definitely save some $63,500,000 a year. But from Puerto Rico's point of view independence of this character would be almost disastrous. The prestige of sovereignty and the assistance Puerto Rico might expect as one more "good neighbor" would certainly not counterbalance the serious loss in Federal aid, Federal direct expenditures, and the sale of its sugar in the rich and protected United States market.

Statehood

If the United States feels that its dealings with Puerto Rico have ethically implied the obligation of eventual statehood, irrespective of Continental United States interests, it would be logical to offer the Island statehood. In this way the United States could give less emphasis to Puerto Rico as a special problem, and Puerto Rico itself would have a voice equivalent roughly to its population in deciding Federal policies which might affect it. But statehood would have certain economic disadvantages for Puerto Rico, such as the following:

Development Plan for Puerto Rico
1. Although, as a State, Puerto Rico might well wield influence above that implied in its electoral vote, because it possesses little historical connection with either of the two dominant continental political parties, it would through its radically different cultural background probably be underrepresented relative to other States in the national executive and judicial administration, where so large a part of modern governmental policy determinations are made.

2. Puerto Ricans would become subject to Federal taxation, probably in an amount of about $21,700,000, and would lose the $14,000,000 of excise and custom taxes now returned to them.

3. It is improbable that Puerto Rico, any more than other individual States with similar interests, could obtain special exemption from coastwise shipping laws or specific tariff items.

Except for these disadvantages, mere statehood for Puerto Rico would have little effect upon its economic relations with the United States. On the other hand, the Federal Government might spend directly some $2,500,000 more in the Island to increase per capita expenditures in Puerto Rico to that of the average in the Southeastern States.

Present Status

Under either independence or statehood, questions of mutual responsibilities and varying self-interests automatically solve themselves; but under the indefinite status in which Puerto Rico now finds itself, the question of mutual responsibilities and powers must be consciously determined by the mother country with whatever collaboration the Island is able to give. Generally speaking it is impossible to plan for any dependent area until these determinations have been clarified. Under either integration (which in the United States would imply statehood) or independence, for instance, the question of living standards is resolved more or less unconsciously and automatically by majority preferences and local resources; but under colonial conditions living standards are dependent upon definite, rational decisions of the mother country. In other words it is the mother country which must consciously determine whether it wants a colony to have standards of living "A" or standards of living "B." As long as it does not allow the colony freedom (as in a sovereign nation) or participation (as in a state) to determine policies which affect its own development, it cannot avoid this responsibility by saying that the standard may be determined by the colony and be limited only by the colony's own resources and ability. Colonialism is not a "laissez-faire" system politically—nor should it be economically.

But, although purely pecuniary considerations might on the one hand encourage the United States to make Puerto Rico independent and on the other hand encourage Puerto Rico to keep the present status, money is not the sole consideration. The United States, for instance, is sincerely anxious to demonstrate that it can be just in its own relationships with all "outside" groups in this hemisphere, although at the same time it is presumably also anxious to maintain Puerto Rico as a market for its industrial goods. Finally it has possibly assumed by its mere occupation a duty toward the Island which equity will not permit it to disregard. Puerto Rican students of these matters, on the other hand, realize that to some extent the responsibility for one's own destiny is worth values which money alone cannot buy. Puerto Rico first relied upon Spain, then upon the United States; and conditions did not appreciably improve. Perhaps if the Island were definitely responsible for its own affairs it might discover heretofore unknown human resources within itself. If one has to sink or swim, one may find that it is possible to swim.

Voluntary Federation

There is also a fourth type of status: that of voluntary federation with the United States either bilaterally or, if other Caribbean countries were included, multilaterally. In British terminology this is called Dominion Status. Under such an arrangement the United States and Puerto Rico could enter into a treaty relationship which would specify the duties and rights of each partner as sovereign states. Presumably such an agreement might provide for autonomous tariff control by both parties, subject to bilateral preferential treatment and for continued aid in some form from the United States.14 This last status would, in effect, imply that the United States had a moral obligation toward Puerto Rico as distinct from any toward Cuba for instance; but the United States would no longer undergo continued expansion of population. Puerto Rico could plan its own future, without risking any immediate loss in income, for the Island would then become responsible for that future and would have only itself to question if the future were unacceptable. It would, in short, become the responsibility of Puerto Rico itself to determine whether it wanted to raise its own existing living standards and, if so, to determine what means were available. The following are merely suggested standards and suggested means. Their realization can only come about if they—or any other—are accepted by the people of Puerto Rico.

14 The Industry and Commerce Section of the Plan contains one of several possible sets of arrangements.
Goals To Plan For

As the end of all human activity is the satisfaction of human wants, it is necessary to determine what the wants of a community are before we can plan how to satisfy them. Those "wants" which should be satisfied to maintain human life at an efficient energy level are referred to as living standards. They are minimum standards if anything less would not allow a man to live and work efficiently. But absolute minimum standards of this character, expressed in definite and quantitative terms, have unfortunately not been developed. For instance, even dietary standards, for which more data are available than for any other, do not definitely indicate what the optimum point is, i.e., at what point the additional consumption of goods and services will produce less capacity for additional work than would be required to produce those goods and services. Another question in establishing minimum standards is whether they should be adjusted to the resources of each community; that is, whether they should be locally attainable. Certain sections of any community may not be able, because of limited human or other resources, to realize the standards which other sections might establish as minima. Is the general community to which the less fortunate sections belong responsible for helping them attain the minimum standards established by the community as a whole? Or should minimum standards vary between sections within a community, lower standards for people in the mountains, higher for those in the rich plain lands, lower for those on offshore islands, higher for those on the continental mainlands?

In general, it is maintained that standards which are really minimum in the sense defined above are those which all parts of a community should enjoy, provided—and this is a fundamental proviso—that any deficit section of a community will do whatever lies within the power of that section to attain these standards for itself before it has any "right" to call upon the community for help. In actuality, resources are not usually distributed within nations or communities so that every section is similarly blessed. A less privileged section of a community may have to work harder or perhaps accept the minimum living standards in less palatable or desirable forms than the more privileged sections if it wants to enjoy the same minima. Such a section must also assume responsibility for trying to adjust its population numbers to its resources. Nations which have been unwilling to accept their limited resources and adjust their numbers to them have often become aggressors, and not always successful aggressors. Similarly, more fortunately situated nations, by not recognizing the rights of all human beings to cer-
elements recommended by the National Research Council and those of the Minimum Wage Board and the National Resources Planning Board have been adapted to suit local food production and local food tastes. Both the standards for clothing and housing have been based on actual requirements for a tropical climate.

These standards are certainly adequate to maintain life at an efficient energy level; for they all provide (in value) for at least twice as much as the goods and services at present consumed by the lower-income groups in Puerto Rico. And, of course, existing substandard conditions actually do perpetuate the life cycle although with hunger and malnutrition. Whether these standards are “realizable” is less evident, for we do not know what the total production of goods and services in Puerto Rico is or, therefore, whether from this total there can be secured the goods and services required by the minimum standards.

It would appear, however, that, as discussed above and elaborated in the Income Distribution section of this plan, whatever the Island’s total income may be, the vast majority of Puerto Rican families are now living at a level one-half to one-third that required by these minima. If 300,000 of Puerto Rico’s 350,000 families live on less than $350 a year, the new standards would mean that the goods and services provided for these 300,000 families should be doubled or tripled. In other words, the income of these 300,000 families should be raised from $105,000,000 a year to $210,000,000 or $315,000,000. In addition, income amounting annually to from $5,000,000 to $10,000,000 would be required to provide such minimum amounts of goods and services for the net addition of approximately 6,000 families a year to the island’s population. Whether Puerto Rico can increase its production to such an extent will be examined below, but these are the goals to plan for.
Any standard of living will remain on paper unless action is taken to convert it into facts, and it is the function of a development plan to indicate how this translation from theory to fact can be effected. There appear to be only four basic means of attacking the problem of want and of securing the kind of life toward which all human beings have forever been striving.

As has been said, if "standards" are set too high for any single community within a larger group, the group as a whole may have to be called upon for assistance. This is what happens in many countries where the national government collects more from one section of the Nation than it returns to the section or spends on it. It is a recognized technique for equalizing income distribution on a geographic basis. In the case of Puerto Rico it is more striking than for any State. For, whereas Puerto Rico profits from Federal grants-in-aid and from direct Federal expenditures, it does not directly contribute any funds to the Federal Government. The total amount of this Federal assistance has been summarized in the discussion of political status. Under these circumstances and in view of the Development Plan's basic assumption that Puerto Rico should try to become less dependent economically so that it can be more independent politically, it is questionable whether any plan to attain the suggested objectives which is based on additional assistance from outside would be either realistic or even desirable. Certainly it is true that continued reliance upon outside help (except, of course, to relieve war-brought distress, which is really the responsibility of all the United Nations together) may only aggravate the problem by not encouraging needed reforms, needed expansion of resources, or needed adjustments in population, and by preventing the development of that feeling of self-reliance and responsibility which is an absolute prerequisite for the attainment of the other objectives. This approach to the problem is, therefore, not further considered except as a wartime, distinctly emergency measure. It should, of course, be recognized that, until basic adjustments are effected in Puerto Rico as in many "deficit" States, present Federal expenditures cannot be reduced without incalculable suffering.

The second approach is obviously that of increasing the productivity of the island's own land, capital, and labor. For any deficit section should first utilize all its own resources, including its labor, to the fullest extent before it has a "right" to call on the community for additional assistance. This is the creative solution to the "problem" of Puerto Rico which has been given most emphasis in the Plan; for it has been felt that this is the most natural and desirable way to bring population and resources into adjustment.

A third approach is also associated with the attainment of these minimum standards. This regards human beings as the greatest single asset of any community and suggests ways in which this asset may be best adjusted to the resources available and to their planned expansion.

And finally, different patterns of income distribution may in effect tend to raise general living standards both by reducing payment to outside capital and equalizing, to whatever degree seems desirable, domestic inequalities.

**Development of Resources and Facilities**

The resources of Puerto Rico would be considered abundant for a population of 1 million people, limited for a population of 2 million, and meager for a population of 3 million. They are:

- Average annual rainfall of 71 inches with a minimum of 25 inches and a maximum of 200 inches.
- Average temperature of 75° for winter and of 80° for summer, with a minimum of 41° and a maximum of 102°.
- Continual trade winds.
- Sixty-eight thousand potential horsepower of hydroelectric energy, developed and undeveloped.
- Adequate amounts of silica sand, clay, and limestone for commercial exploitation.

One million acres of arable land of which only 28.2 percent is rated at 5 or better in productivity.¹

Four good natural harbors.

Population of 1,870,000 people, which is 65 percent literate.

Some of these resources have already been developed or utilized to a considerable degree, but none have been developed to their fullest extent. Although the points of diminishing returns in their exploitation may be lower than in the exploitation of similar but richer resources elsewhere, they are not so low that they require the backbreaking kind of toil which alone can wrest a living from many places in the world. Nevertheless...

¹ Productivity ratings range from 1, the highest, to 10, the lowest.
they probably do require much harder work, much greater concentration, and much more enterprise than have been applied to them in the past. Of course, if radical advances, perhaps in agrobiology or in electrotechnology, can successfully be applied to these resources, then they might no longer be "limited" for a population of 2 million or even more. But, since such advances cannot now be measured, the Development Plan for Puerto Rico must be based realistically upon the best of present practices.

The Land and its Fruits

Present Land Use, Productivity, and Tenure

Agriculture is the single most important source of income for the Island, and the single most important source of labor, for almost the entire population gains its livelihood either directly or indirectly from it. The rural sections of the Island are also important because 70 percent of the population live in the open country. But the land uses and productivity of the Island are, therefore, fundamental to its future welfare.

Land use.—The Census of Agriculture for 1940 gives the types of agricultural land use for Puerto Rico shown in table 1.

<table>
<thead>
<tr>
<th>Land use</th>
<th>Cuerdas</th>
<th>Percent of farm land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total land area</td>
<td>2,255,684</td>
<td>100.0</td>
</tr>
<tr>
<td>Land in farms</td>
<td>1,885,874</td>
<td>83.6</td>
</tr>
<tr>
<td>Cropland</td>
<td>1,053,314</td>
<td>55.9</td>
</tr>
<tr>
<td>Harvested</td>
<td>730,731</td>
<td>39.2</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>220,760</td>
<td>11.3</td>
</tr>
<tr>
<td>Tobacco</td>
<td>26,284</td>
<td>1.4</td>
</tr>
<tr>
<td>Other field crops</td>
<td>380,178</td>
<td>20.2</td>
</tr>
<tr>
<td>Coffee</td>
<td>141,109</td>
<td>7.5</td>
</tr>
<tr>
<td>Vegetables</td>
<td>8,600</td>
<td>0.4</td>
</tr>
<tr>
<td>Fruits (except coffee)</td>
<td>83,035</td>
<td>4.5</td>
</tr>
<tr>
<td>Not harvested</td>
<td>131,205</td>
<td>7.0</td>
</tr>
<tr>
<td>Pasture</td>
<td>418,871</td>
<td>22.3</td>
</tr>
<tr>
<td>Clear (plowable)</td>
<td>300,369</td>
<td>16.0</td>
</tr>
<tr>
<td>Woodland and other</td>
<td>318,605</td>
<td>17.1</td>
</tr>
<tr>
<td>Other land</td>
<td>233,689</td>
<td>12.5</td>
</tr>
<tr>
<td>Woodland not pastured</td>
<td>181,911</td>
<td>9.7</td>
</tr>
<tr>
<td>All other</td>
<td>81,778</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Table 1.—General land uses, Puerto Rico, 1939

The soil itself, which was not extremely fertile at the time of the first Spanish settlement nearly four and a half centuries ago, has been subject to much abuse through continued use for specialized farming without adequate provisions for conserving its productive qualities. Nearly 70 percent of the total land area is subject to moderate or severe sheet erosion, with more than 25 percent of the top soil washed away. Since much of this highly eroded land is in the mountainous areas, the effect of erosion on productivity has been less than these figures might indicate. But the loss of good topsoil from hillside fields only serves to aggravate the increased pressure of people on the land. Of the 845,056 cuerdas well adapted to cultivation, according to the Soil Conservation Service, 75 percent require complex or intensive practices, and of the land suited to pasture 63 percent require similar practices. These land problems have been further complicated by natural conditions such as periods of drought, heavy tropical rains, and hurricanes. The latter have caused great destruction of property through both wind and floods. Although averages cannot be relied upon too heavily in discussions of weather, 22 hurricanes have struck the Island during the past 116 years, or an average of 1 every 5 years.

That the total amount of land in farms has decreased steadily since 1909 and more rapidly since 1929 can be seen in table 2.

Table 2.—Land in farms, Puerto Rico, selected years, 1909-29

<table>
<thead>
<tr>
<th>Year</th>
<th>1909</th>
<th>1919</th>
<th>1929</th>
<th>1935</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land in farms (thousands of cuerdas)</td>
<td>2,305</td>
<td>2,022</td>
<td>1,979</td>
<td>1,913</td>
<td>1,866</td>
</tr>
<tr>
<td>Percent decrease (each decade)</td>
<td>92.4</td>
<td>90.6</td>
<td>87.8</td>
<td>84.8</td>
<td>83.6</td>
</tr>
</tbody>
</table>

The decrease is due to natural extension of nonfarm land uses, to abandonment of land unsuitable to farming, and to Government purchases. At the same time the land in farms is being used more intensively, and production, particularly in sugarcane, has greatly increased in the past 40 years. Table 3 shows land harvested in various principal crops at each decennial census since the special census of 1899. Comparison of tables 2 and 3 will emphasize the important fact that, while land in farms has been decreasing, the amount of crops harvested has been increasing. The increased production which this signifies has responded to the greater demands made on the land by a population which has nearly doubled in this period. A study of the specific crops—sugarcane, tobacco, and some fruits—

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1 cuerdas is equivalent to 0.9712 acre.
2 Includes land subject to crop failure, in crops for future harvest, in soil improvement crops, lying fallow, or idle.

Source: U. S. Census of Agriculture, 1940.
Development Plan for Puerto Rico

Figure 4

PUERTO RICO
TYPES OF FARMING

LEGEND

- Sugar cane
- Pineapples
- Subtropical crops
- Coffee
- Grapes
- Cocos
- Taro and other subtropical crops
- Sugar cane
- Tobacco

Scales in miles

Prepared by the Office of the National Resources Planning Board

Puerto Rico

Types of Farming

Legend

Figure 4
in which this increased production has been outstanding, indicates what influence the extension of the tariff and coastwise shipping laws and markets in the United States have had on Puerto Rico’s agricultural economy.

Table 3.—Crop acreages harvested, Puerto Rico, selected years, 1899-1939

<table>
<thead>
<tr>
<th>Crop</th>
<th>1899</th>
<th>1909</th>
<th>1919</th>
<th>1929</th>
<th>1935</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total crop area harvested</td>
<td>391.5</td>
<td>542.7</td>
<td>680.2</td>
<td>737.6</td>
<td>658.6</td>
<td>828.0</td>
</tr>
<tr>
<td>Sugar cane</td>
<td>70.1</td>
<td>143.4</td>
<td>227.8</td>
<td>237.6</td>
<td>265.2</td>
<td>222.8</td>
</tr>
<tr>
<td>Tobacco</td>
<td>5.8</td>
<td>22.1</td>
<td>39.1</td>
<td>52.9</td>
<td>45.7</td>
<td>28.6</td>
</tr>
<tr>
<td>Coffee</td>
<td>181.4</td>
<td>186.9</td>
<td>190.6</td>
<td>191.7</td>
<td>182.3</td>
<td>181.1</td>
</tr>
<tr>
<td>Cotton</td>
<td>(1)*</td>
<td>1.4</td>
<td>2.8</td>
<td>10.3</td>
<td>0.9</td>
<td>3.4</td>
</tr>
<tr>
<td>Corn</td>
<td>17.6</td>
<td>50.6</td>
<td>56.8</td>
<td>70.2</td>
<td>69.8</td>
<td>59.4</td>
</tr>
<tr>
<td>Rice</td>
<td>4.4</td>
<td>10.1</td>
<td>11.7</td>
<td>9.2</td>
<td>6.4</td>
<td>13.8</td>
</tr>
<tr>
<td>Dry beans</td>
<td>(1)*</td>
<td>15.7</td>
<td>34.4</td>
<td>40.9</td>
<td>31.5</td>
<td>48.4</td>
</tr>
<tr>
<td>Sweetpotatoes</td>
<td>35.1</td>
<td>(1)</td>
<td>31.8</td>
<td>47.6</td>
<td>35.9</td>
<td>49.9</td>
</tr>
<tr>
<td>Yams</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>10.7</td>
<td>8.8</td>
<td>6.8</td>
</tr>
<tr>
<td>Yautias</td>
<td>(1)</td>
<td>(1)</td>
<td>(1)</td>
<td>16.7</td>
<td>17.6</td>
<td>22.1</td>
</tr>
<tr>
<td>Vegetables</td>
<td>(1)*</td>
<td>88.2</td>
<td>32.4</td>
<td>12.0</td>
<td>3.6</td>
<td>6.9</td>
</tr>
<tr>
<td>All other crops</td>
<td>60.3</td>
<td>28.2</td>
<td>57.7</td>
<td>47.1</td>
<td>27.7</td>
<td>17.6</td>
</tr>
</tbody>
</table>

1 As explained above inter-croppings will make “total crop area harvested” considerably higher than “cropland harvested”; the latter figure for 1939 was 739,751 cuerdas.

2 Not reported separately.

3 Includes farm gardens, sweetpotatoes, and yams.

4 Includes approximately 30,000 cuerdas of forage crops.

Source: U. S. Census of Agriculture, 1940.

In 1939, as these figures show, sugarcane, the Island’s most valuable crop, was harvested on nearly 230,000 cuerdas, representing the best agricultural land. This land was four times that harvested in any other single crop, with the exception of coffee. (See fig. 5.) Of the major crops, sugarcane has also shown the greatest absolute increase in land harvested, particularly in the first decade of this century; for between 1899 and 1909 sugarcane acreage more than doubled. Though the acreage of cane in 1935 was 70 percent above 1909, sugar controls and market conditions caused a decrease between 1935 and 1939 of 6 percent. The cuerdas harvested in 1939 were about the same as the number harvested in 1919. It should be noted, however, that the

Puerto Rico Planning Board

In 1939, as these figures show, sugarcane, the Island’s most valuable crop, was harvested on nearly 230,000 cuerdas, representing the best agricultural land. This land was four times that harvested in any other single crop, with the exception of coffee. (See fig. 5.) Of the major crops, sugarcane has also shown the greatest absolute increase in land harvested, particularly in the first decade of this century; for between 1899 and 1909 sugarcane acreage more than doubled. Though the acreage of cane in 1935 was 70 percent above 1909, sugar controls and market conditions caused a decrease between 1935 and 1939 of 6 percent. The cuerdas harvested in 1939 were about the same as the number harvested in 1919. It should be noted, however, that the
per cuerda yield increased from 17.4 hundredweight in 1919 to 31.5 hundredweight in 1939, or 81 percent.

Coffee is the next most important single crop in terms of area, but it does not represent so intensive a use of land as sugarcane and other crops, for coffee cultivation is confined to the western inland highlands, where soils are relatively thin and slopes are relatively steep. Puerto Rican coffee was once a major source of cash income and was exported to favorable markets in Europe, where it was highly valued as an after-dinner coffee. Although acreage itself shows very little change between 1919 and 1939, the coffee region has developed into a blighted area of bankrupt farms, principally because of the hurricanes of 1928 and 1932 and the loss of markets abroad. With these changes, the production for home consumption of other crops in the coffee area was increased, as census data show. This was facilitated by the fact that fruit trees, particularly bananas and plantains, are often planted between the coffee trees, permitting the land to produce two or more crops at the same time.

Tobacco of the cigar-filling type is grown in the eastern highlands. Like coffee, it was formerly very important as an export crop principally to the United States markets. Tobacco expanded very rapidly up to the middle twenties, when market difficulties and production problems forced curtailment. Although nine times as much land, or about 53,000 cuerdas, was harvested in tobacco in 1929 as in 1899, by 1939 the amount of tobacco land had dropped to 29,000 cuerdas.

Ten thousand cuerdas of cotton were picked in 1929, after a rapid increase in acreage during the preceding 10 years. In the following decade, the acreage dropped again to only 3,400 in 1939. Cotton, particularly the long-staple variety, has recently received renewed attention as a valuable cash crop, and its acreage increased to about 12,000 cuerdas in 1942-43.

Although, before the present war, increasing population pressure on the land had increased its value and had thus not encouraged the expansion of food crops, acreage harvested in these crops had actually increased from approximately 121,000 cuerdas in 1899 to 355,000 in 1939. (Owing to the practice of intercropping, considerably less land was actually devoted to them than indicated by the acreage harvested.) Vegetable production as part of these food crops was relatively unimportant during the period, partly because the economic situation of most Puerto Rican families forced the consumption and, therefore, the planting of cheap, concentrated foods. Since the war, however, various Federal and Insular campaigns to expand local food production have resulted in an estimated increase between 1939 and 1942 of 28 percent in land harvested in food crops. Finally, it is necessary to note that, as the best lands in Puerto Rico are usually reserved for sugarcane and since the smaller farmers who grow the bulk of the Island's food crops possess only limited means and skills for their cultivation, food yields are not nearly so high as the average in the United States.

In discussions of agriculture in Puerto Rico, the livestock industry is sometimes neglected; yet it is relatively important. In 1937-38 the estimated retail value of all locally produced foods was $45,000,000, of which $13,500,000, or 29 percent, were from dairy and meat products. Since 1920, however, there has been no great increase in the number of livestock, as table 4 shows.

Table 4.—Number of livestock, Puerto Rico, selected years, 1910-40

<table>
<thead>
<tr>
<th></th>
<th>1910</th>
<th>1920</th>
<th>1930</th>
<th>1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle and calves</td>
<td>313,883</td>
<td>252,710</td>
<td>236,235</td>
<td>266,734</td>
</tr>
<tr>
<td>Horses and colts</td>
<td>18,325</td>
<td>16,625</td>
<td>14,125</td>
<td>13,625</td>
</tr>
<tr>
<td>Goats and kids</td>
<td>12,475</td>
<td>11,875</td>
<td>11,375</td>
<td>11,875</td>
</tr>
<tr>
<td>Hogs and pigs</td>
<td>19,475</td>
<td>16,625</td>
<td>15,125</td>
<td>14,625</td>
</tr>
<tr>
<td>Chickens</td>
<td>9,475</td>
<td>8,625</td>
<td>8,125</td>
<td>7,625</td>
</tr>
<tr>
<td>Total</td>
<td>383,750</td>
<td>316,250</td>
<td>294,000</td>
<td>342,400</td>
</tr>
</tbody>
</table>

The principal reasons for this static condition are the scarcity of open pasture land, the lack of extensive research in animal husbandry under the tropical conditions of Puerto Rico, and a lack of interest in clearing brushlands for pasture. The need for additional livestock products is certainly very great. Even for the very simplest dietary level, Puerto Rico should increase its cattle for slaughtering three and one-half times, cattle for milk six and one-half times, chickens for eggs eight times.

Under certain conditions this expansion might be accomplished by the importation of concentrated feeds, as was done in Denmark and is now done in Puerto Rico for a limited market, but in Puerto Rico the bulk of consumers simply could not afford the high prices which would have to be charged. The other alternative is an intensification of small-animal husbandry—chickens, goats, pigs, rabbits—on a modest scale in both rural and suburban homesteads and a better utilization of pasture. It has also been suggested that livestock production could be expanded on a strictly commercial basis. An authority in tropical agriculture has stated that in the West Indies, instead of 3 acres being required to support one head of cattle (the usual prac-

1. The census figure, like that for sugar, for the same year, does not correspond to that of other responsible sources. The official Tobacco Institute, for instance, indicates that only 15,600 acres were planted to tobacco in 1938-39, and that by 1940-41 the acreage had reached 46,314, the fifth highest acreage in the last 30 years. These discrepancies indicate the need for thorough review of the Island's statistical data, so that such dissimilar figures may be reconciled.


tice when no concentrates are employed), three head should be supported by each acre. Such an increase in productivity would have to result from intensive scientific agriculture. To base such intensive utilization upon sound principles, investigation along at least the following lines should be undertaken:

1. Utilization of more nutritious grasses for forage.
2. Utilization of local materials for concentrates, including feeding of molasses and yeast. 

The present relative position of Puerto Rico in the production of milk is indicated in a study by Robert Bayle, "A Farm Management Study of 10 Dairy Farms in Puerto Rico, 1935-1936, Agricultural Experiment Station, Rio Piedras, P. R., in which the following introductory statement is found: "The temperature is too warm to favor a high production per cow. Methods of feeding and management have been inadequate. Added to these conditions is the fact that much of our native cattle stock is of a nondescript breed and the male animals have been used mainly for work purposes. For all these reasons the [annual] production of milk per cow is low. According to the 1935 Census of Agriculture, the [annual] production of milk per cow in Puerto Rico was about 1,657 pounds. This production is low as compared to about 4,500 pounds per cow in the United States and about 5,000 pounds in Holland."

Dr. Joseph H. Axtmayer, Vice-Rector, University of Puerto Rico, has stated: "I believe that Puerto Rico can produce enough cottonseed, peanut, and coconut meal cake, when diluted with edible dried ground roots and corn and supplemented with minerals such as ground bone meal, to supply a major portion of the demand for concentrates used in the dairy industry."

3. More scientific farm management, utilizing in the dry areas trench silos for carrying livestock during dry seasons, and improving pastures now underutilized.
4. Development of local breeds of cattle which will not require continual addition of imported stock.

Productivity.—Productivity as well as acreage determines total farm income. Only 28.2 percent, or less than 640,000 cuerdas, of the land of Puerto Rico was rated 5 or above in general productivity by the United States Department of Agriculture in its Soil Survey of Puerto Rico published in 1942. Soils with the highest ratings of 1 and 2 occupy but 8 percent of the land area of the island. These productivity ratings are discussed in more detail in the section on potential productivity, since they form the basis for determining how the ultimate productivity under present conditions might be determined.
The most productive soils on the Island lie in the river flood plains adjacent to the stream channels of the Island’s many rivers and spread out at the coast to form a band of varying width along most of its length. (See fig. 6.) They lie inland from the less productive sandy and poorly drained organic and mineral soils of the immediate coast. Nearly 90 percent of the soils of the river flood plains is planted to sugarcane, and most of the rest is in malojillo grass, used for feed by the dairy farmers. Sugarcane yields reach as high as 100 tons to the cuerda on this land. Less productive but very desirable soils are found in the river terraces and alluvial fans, adjacent to the river flood plains, slightly higher than the latter, large in area, and nearly level. Of these soils more than 75 percent is used for sugarcane. The soils of the smooth coastal plains form a broken 8-mile-wide strip along the north central and northwestern coasts. Although deep, friable, and well-drained, these soils have been extensively leached of their plant nutrients and produce lower yields than the other soils previously discussed. Along the southern and southeastern coasts the plain becomes very narrow and in some areas disappears, or is cut by arms of the central mountain range. The soils of the inner plains and colluvial slopes lie generally between the uplands and the coastal plains. They are fairly deep and fertile, generally moist, and vary in relief from gently sloping to strongly undulating. In the soils of the uplands which occupy the interior of the Island and are the least fertile of all, coffee, tobacco, fruits and food crops, and some sugarcane are grown. In higher altitudes and on steeper slopes, the soils are thin and are so exposed to the action of the wind and rain that few crops can successfully be grown.

Thus, although Puerto Rico has areas of high fertility and adequate rainfall to produce large crop yields, these areas are distinctly limited to but a small percentage of the total area of the Island. Although virtually all of the land is used for some productive purpose, it is not, except for that in sugar, used as efficiently as possible. In contrast to other densely inhabited agricultural countries, such as China, Java, and Japan, which have adopted a very thorough system of crop cultivation and maintained soil productivity for many centuries, Puerto Rico continues to employ obsolete farming methods. This is due primarily to a lack of farming knowledge, whether traditional or acquired, and to the extreme poverty of the non-sugar farmers which prevents and discourages the undertaking of farm improvements. Puerto Rican agriculture is a picture of extremes. On the one hand are large sugar corporations employing modern techniques of scientific management, and on the other is subsistence farming based on primitive methods. Between these two extremes there are small-scale commercial agricultural enterprises.

As noted above, to counteract the fundamental shortcomings faced by Puerto Rican agriculture—namely, scarcity of land, with soils generally low in productivity and depleted by many years of constant use—the Island has specialized in the production of two types of crops: export crops, and crops for domestic consumption which give a high return in terms of food value per acre. The income derived from the former is used to provide “exchange” for the purchase of consumer and producer goods abroad, chiefly from the United States. But in so doing the Island’s climate and soils have forced it unfortunately to grow crops which can be produced at lower costs by other countries whose land is more fertile, and cheaper, whose labor rates are lower, and which have land available for expanding production. That under such circumstances Puerto Rican agriculture has been able to exist and to expand its production during the past forty-odd years is due principally to the facts that, like continental agriculture, it has been protected by the high tariff policy of the United States, that it has received other Federal and Insular subsidies, and that it has had access to the large and wealthy market of the United States.

Even under protection, however, Puerto Rico finds difficulty in competing with continental citrus-producing regions and with other off-shore pineapple producers. It has also been said that certain United States reciprocal trade agreements, particularly with Cuba, have affected adversely the possibility of Puerto Rico’s development as a producer of specialty crops and winter vegetables for the northern market. The difficulties encountered in developing new tropical crops in Puerto Rico are discussed in a later section of this report. Thus it appears clear that Puerto Rico’s present agriculture is based on the United States tariff, but that even this is not sufficient to encourage expansion in many new tropical or subtropical crops. An economic structure has been created whose future is precarious, because it is peculiarly dependent upon political arrangements.

Table 5 summarizes the success to date in increasing the yields per acre of sugarcane and tobacco, and to a lesser degree of other cash export and food crops. The right-hand columns offer a comparison of yields with the yardstick of population increase, to indicate the varied success in keeping total production in step with the growth of the people who must earn their living from it.

It can be seen from this table that, while the yield per cuerda of sugarcane has increased by about 45 percent and of tobacco slightly less, the production per capita has not increased as rapidly. For sugarcane it is 30 percent, and for tobacco about 10 percent. (The latter
To conclude this general discussion of Puerto Rico's agricultural production, it is desirable to relate it to the number of people which could theoretically be supported by it at a given income; for, of course, the reason for production itself is the livelihood which people derive from it. Table 6 summarizes production and value figures for 1939, which it is believed are sufficiently accurate and comprehensive to indicate the magnitude of the Island income from crop production. The total for 1939 is approximately $76,500,000. If we assume that the average family of 5 persons in Puerto Rico needs an income of at least $840 a year, this gross income would support, assuming 1 wage earner per family, about 90,000 families whether working directly on the land or otherwise contributing to the production of this gross income. This number of families represents about 25 percent of the Island's present population. Other forms of production or intensified crop production, therefore, must provide for the remaining 75 percent of the Island’s population. The very purpose of the Development Plan itself is the discussion of such productive possibilities.

Of the $76,500,000 gross crop income, sugarcane income represents 60 percent, although it was grown on less than 30 percent of the total land area harvested and on only 18 percent of all farms. The income and value per acre for pineapples, a valuable crop, were calculated not from the price paid to the farmer, but from the export value. However, pineapples require more care.

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### Table 5—Per cuerda and per capita production of principal field crops, Puerto Rico, selected years, 1909–39

<table>
<thead>
<tr>
<th>Crop</th>
<th>1900</th>
<th>1910</th>
<th>1929</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hundredweight per cuerda</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td>21.9</td>
<td>17.4</td>
<td>23.6</td>
<td>31.5</td>
</tr>
<tr>
<td>Tobacco</td>
<td>4.9</td>
<td>4.9</td>
<td>4.4</td>
<td>5.1</td>
</tr>
<tr>
<td>Coffee</td>
<td>2.8</td>
<td>2.3</td>
<td>1.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Cotton (unligged)</td>
<td>4.4</td>
<td>3.3</td>
<td>5.3</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Pounds per capita</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane</td>
<td>9.1</td>
<td>6.5</td>
<td>8.5</td>
<td>9.9</td>
</tr>
<tr>
<td>Tobacco</td>
<td>4.4</td>
<td>4.4</td>
<td>4.4</td>
<td>4.4</td>
</tr>
<tr>
<td>Coffee</td>
<td>2.3</td>
<td>2.3</td>
<td>1.8</td>
<td>4.3</td>
</tr>
<tr>
<td>Cotton (unligged)</td>
<td>4.4</td>
<td>3.3</td>
<td>5.3</td>
<td>4.8</td>
</tr>
</tbody>
</table>

1 Sugarcane production given in tons per cuerda and tons per capita.

Source: Computed from U. S. Census.

---

### Table 6—Production and income of selected crops, Puerto Rico, 1939

<table>
<thead>
<tr>
<th>Crop</th>
<th>Number of farms</th>
<th>Cuerdas harvested (1,000)</th>
<th>Total (1,000)</th>
<th>Production</th>
<th>Price (cents per pound)</th>
<th>Gross income</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>25,619</td>
<td>99,019</td>
<td>9,683</td>
<td>31.5</td>
<td>$203.87</td>
<td>$46,839,596</td>
</tr>
<tr>
<td><strong>Sugarcane</strong></td>
<td>9,006</td>
<td>228.8</td>
<td>7,237.7</td>
<td>2.61</td>
<td>$203.87</td>
<td>$18,480,061</td>
</tr>
<tr>
<td><strong>Tobacco</strong></td>
<td>16,918</td>
<td>26.6</td>
<td>19,835.4</td>
<td>16.0</td>
<td>$233.37</td>
<td>$4,379,567</td>
</tr>
<tr>
<td><strong>Coffee</strong></td>
<td>22,399</td>
<td>11.1</td>
<td>25,016.0</td>
<td>33.5</td>
<td>$125.24</td>
<td>$3,777,947</td>
</tr>
<tr>
<td><strong>Corn</strong></td>
<td>5,067</td>
<td>181.1</td>
<td>29,062.0</td>
<td>48.1</td>
<td>$16.75</td>
<td>$4,800,877</td>
</tr>
<tr>
<td><strong>Rice</strong></td>
<td>3,021</td>
<td>59.4</td>
<td>1,868.1</td>
<td>3.9</td>
<td>$28.75</td>
<td>$517,050</td>
</tr>
<tr>
<td><strong>Dry beans</strong></td>
<td>4,643</td>
<td>13.8</td>
<td>60.9</td>
<td>3.9</td>
<td>$16.75</td>
<td>$102,499</td>
</tr>
<tr>
<td><strong>Tobacco</strong></td>
<td>38,543</td>
<td>48.4</td>
<td>192.5</td>
<td>2.7</td>
<td>$28.75</td>
<td>$1,069,040</td>
</tr>
<tr>
<td><strong>Sweetpotatoes</strong></td>
<td>993</td>
<td>3.4</td>
<td>1,637.1</td>
<td>16.0</td>
<td>$517,050</td>
<td>$48,135</td>
</tr>
<tr>
<td><strong>Yautia</strong></td>
<td>32,999</td>
<td>40.0</td>
<td>1,338.0</td>
<td>6.0</td>
<td>$28.75</td>
<td>$962,338</td>
</tr>
<tr>
<td><strong>Pigeon peas</strong></td>
<td>24,189</td>
<td>221.1</td>
<td>4,271.1</td>
<td>1.9</td>
<td>$28.75</td>
<td>$717,043</td>
</tr>
<tr>
<td><strong>Other field crops</strong></td>
<td>27,322</td>
<td>88.3</td>
<td>1,877.5</td>
<td>2.7</td>
<td>$28.75</td>
<td>$697,391</td>
</tr>
<tr>
<td><strong>Bananas</strong></td>
<td>6,063</td>
<td>15.6</td>
<td>947.7</td>
<td>2.7</td>
<td>$28.75</td>
<td>$170,454</td>
</tr>
<tr>
<td><strong>Plantains</strong></td>
<td>2,885</td>
<td>47.1</td>
<td>16,014.5</td>
<td>1.9</td>
<td>$28.75</td>
<td>$3,807,658</td>
</tr>
<tr>
<td><strong>Oranges</strong></td>
<td>13,933</td>
<td>16.8</td>
<td>225,193.2</td>
<td>3.9</td>
<td>$28.75</td>
<td>$6,782,722</td>
</tr>
<tr>
<td><strong>Grapefruit</strong></td>
<td>10,083</td>
<td>6.9</td>
<td>116,273.6</td>
<td>1.88</td>
<td>$28.75</td>
<td>$3,947,041</td>
</tr>
<tr>
<td><strong>Coffee</strong></td>
<td>6,266</td>
<td>4.8</td>
<td>24,826.0</td>
<td>3.9</td>
<td>$28.75</td>
<td>$727,067</td>
</tr>
<tr>
<td><strong>Pineapples</strong></td>
<td>11,999</td>
<td>13.0</td>
<td>21,776.8</td>
<td>3.7</td>
<td>$28.75</td>
<td>$697,391</td>
</tr>
<tr>
<td><strong>Total fruit</strong></td>
<td>256</td>
<td>1.8</td>
<td>378.2</td>
<td>2.7</td>
<td>$28.75</td>
<td>$170,454</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25,619</td>
<td>99,019</td>
<td>9,683</td>
<td>31.5</td>
<td>$203.87</td>
<td>$46,839,596</td>
</tr>
</tbody>
</table>

1 New York price less shipping and selling expenses. Source: Sugar Producers Association.
2 Department of Agriculture and Drountage, Annual Report of Statistics, 1939–40, p. 211.
3 Ibid., p. 187, retail prices. U.S. prices of large amount of production is retained by producer.
4 Ibid., p. 187, prices for ginned cotton, 30 percent lint assumed.
5 Includes potatoes, yuca, and manioc.
6 Includes eggplant, squash, cucumbers, green beans, lettuce, cucumbers, peppers, okra, cabbages, tomatoes, and others.
8 Includes plantains and bananas.

Sources: Number of farms, cuerdas harvested, and production from U. S. Census of Agriculture, 1940. Prices either market, farm, or retail. Latter's use justified in certain instances by higher percentage consumed on farm or sold directly at retail by the farmer.
ful attention than any other commercial crop grown on the island, so that cultivation and handling costs are high and its net income is, therefore, not so large as its gross income might indicate. With the exception of sugarcane, tobacco, and a few fruits, the gross income for individual crops is considerably less than $75 per cuerda. Corn, coffee, and rice are the lowest income producers.

Tenure.—The production of agricultural products is influenced, finally, by prevailing institutions of land tenure and farm size as well as by land area and productivity. A discussion of these must recognize certain outstanding facts. In Puerto Rico in 1940, 2.9 percent of all farms—namely those of 175 cuerdas and more—included 49.1 percent of the total farm land and 36.4 percent of the cropland. The land, buildings, implements, and machinery of these few large farms were valued at 61.3 percent of the total farm value. About 53 percent of the number of all farms had less than 10 cuerdas, and included only 7.7 percent of all farm land; nearly three-quarters had less than 20 cuerdas; and nearly 90 percent had less than 50 cuerdas. The average size of all farms, large and small, in that year was 34 cuerdas, but the median was only 9 cuerdas. Farm sizes, the farm and crop land included in each, and farm value are given in table 7.

<table>
<thead>
<tr>
<th>Size of farm (cuerdas)</th>
<th>Farms, 1940</th>
<th>All land in farms</th>
<th>Cropland</th>
<th>Value of land, buildings, implements, and machinery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>1,000 cuerdas</td>
<td>Percent</td>
<td>1,000 cuerdas</td>
</tr>
<tr>
<td>Under 3</td>
<td>3,108</td>
<td>2.2</td>
<td>143.3</td>
<td>6.1</td>
</tr>
<tr>
<td>5-9</td>
<td>26,172</td>
<td>16.7</td>
<td>258.6</td>
<td>13.7</td>
</tr>
<tr>
<td>10-19</td>
<td>11,286</td>
<td>33.3</td>
<td>191.7</td>
<td>10.2</td>
</tr>
<tr>
<td>20-49</td>
<td>5,275</td>
<td>15.4</td>
<td>206.8</td>
<td>11.0</td>
</tr>
<tr>
<td>50-69</td>
<td>5,200</td>
<td>5.5</td>
<td>156.5</td>
<td>8.1</td>
</tr>
<tr>
<td>100-174</td>
<td>1,304</td>
<td>2.7</td>
<td>191.7</td>
<td>10.2</td>
</tr>
<tr>
<td>175-299</td>
<td>646</td>
<td>1.2</td>
<td>132.6</td>
<td>7.2</td>
</tr>
<tr>
<td>300-499</td>
<td>269</td>
<td>0.4</td>
<td>158.8</td>
<td>8.2</td>
</tr>
<tr>
<td>500-999</td>
<td>201</td>
<td>0.3</td>
<td>219.5</td>
<td>11.0</td>
</tr>
<tr>
<td>1,000-4,999</td>
<td>1,107</td>
<td>11.2</td>
<td>206.8</td>
<td>11.0</td>
</tr>
<tr>
<td>5,000 and over</td>
<td>27</td>
<td>0.3</td>
<td>235.1</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>All farms</strong></td>
<td><strong>56,019</strong></td>
<td><strong>100.0</strong></td>
<td><strong>1,885.9</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Source: U. S. Census of Agriculture, 1940.

Since 1910 the number of farms has decreased 4.9 percent and the land in farms has decreased 9.5 percent, the average size of all farms having thus decreased slightly. Between 1910 and 1920 there was apparently a considerable consolidation of farms of under 20 cuerdas; for, while the number of such farms decreased by nearly half, the land in them decreased only 16.7 percent. Within this group, farms of less than 3 cuerdas have lost in number and land, and farms of from 3 to 20 cuerdas have gained considerably in number and land. Table 8 summarizes the trends in number and area of farms from 1910 to 1940 in three major size groups.

<table>
<thead>
<tr>
<th>Size of farm (cuerdas)</th>
<th>Number of farms (1,000 farms)</th>
<th>All land in farms (1,000 cuerdas)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1910</td>
<td>1920</td>
</tr>
<tr>
<td>Under 3</td>
<td>42.0</td>
<td>25.6</td>
</tr>
<tr>
<td>5-9</td>
<td>14.3</td>
<td>13.5</td>
</tr>
<tr>
<td>10-19</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>20-49</td>
<td>28.4</td>
<td>41.1</td>
</tr>
</tbody>
</table>

Source: U. S. Census of Agriculture, 1940.

The large majority of the rural or farming population in Puerto Rico are landless laborers who work for wages on large estates. Only a few of them may be able to grow some food crops for themselves on land belonging to their employer. Table 9 shows that in 1940 there were only 54,000 farmers, or an equivalent number of families, owning or renting their land. It will be noted that manager-operated farms (1) are only 2.3 percent of the total number of farms, but (2) hold 30 percent of all land in farms, and 44 percent of the value of all farm land and buildings, (3) average 440 acres in comparison with 25 and 21 for owner- and tenant-operated farms, (4) average $69,983 in value in comparison with $1,847 and $1,523 for owner- and tenant-operated farms, and (5) are worth $135 per acre in comparison with $74 and $71 for owner and tenant-operated farms. As might be expected, tenure is highly variable according to crops and quality of land. In the sugar industry, tenure is concentrated in cane acreage, and in the independent growers, or colonos. Company control in fruit growing is also widespread, owing to the large investment needed for the crops and the resultant high risks involved. In coffee, tobacco, and minor crops, and particularly in the latter, land ownership is more greatly diffused.
Desirable Land Use, Potential Productivity, and Tenure

Future land use.—It can be safely assumed that agriculture will continue indefinitely as the backbone of the Island’s economy, for without sufficient mineral resources industrialization can only hope to complement, rather than supplant, the land in the production of goods and services. Recommendations for a development plan based on this premise must therefore be aimed at the most productive and efficient use of each cuerda of land. Although the responsibility for putting any such plan into effect lies partly with the Federal Insular Governments working in cooperation, it must finally rest with the desire of the people of Puerto Rico to make the best of their own resources.

Increased agricultural production on the basis of better land use cannot hope to keep pace indefinitely with an expanding population where there are no other major means of support. No agricultural community can hope to continue as the backbone of its population on the land as far as an industrialized community can, without running the risk of serious consequences. For this reason, Puerto Rico must formulate and adhere to a sound population policy, necessarily one of restriction of growth. This is discussed more at length in other sections, but it must be emphasized here because there are practical limits to the productive power of any given area of land, which are already being reached in Puerto Rico.

The intensified use of land in the Island, in spite of the decreasing area of farmland, has already been noted. Further possibilities in that direction must be fully explored. Greater systematization and further research are necessary to determine, in so compact an island, the optimum use of every soil type, correlating it with data on climate and erosion. Perhaps only in isolated cases will it be found desirable to change drastically the use of cultivated land, and this can be expected principally in marginal or already blighted areas. For the most part, it will be desirable to intensify the use of fertilizers, soil conservation practices, and modern farm machinery. The latter is important, particularly in sugarcane cultivation. Much good land is devoted to grazing the work oxen which are used to move sugar cane from the fields. As mechanization increases, some of this land will be available for local food crops, and other parts will be available for grazing food-producing animals.

Before planning for land use can be carried further, it is necessary to assemble and outline the steps to be taken and to take stock of what is already known. This is attempted in table 10. Following the table is a list of Federal, Insular, and private agencies interested in land-use problems. It is hoped that the outline herein presented can serve as a guide to those agencies and all other interested organizations and individuals to integrate their efforts, arrive at common bases of data, and agree upon a single program of action.
Development Plan for Puerto Rico

Inherent characteristics:
- Soil characteristics:
- Slopes and erosion:

Hydrologic data:
- Rainfall
- Evaporation
- Run-off
- Ground water

Use characteristics:
- Productivity
- Capability

Present uses:
- General areas
- Specific areas

Desirable uses:
- General
- Specific

Program for action:
- Existing Federal and insular agricultural and private agencies; AAA controls; Land Authority's purchase power; Puerto Rico Planning Board's powers; temporary control over fertilizer; FSA farm management plans.

There are many agencies interested in such a program as outlined in table 10. They include:

Federal agencies:
- Department of Agriculture:
  - Soil Conservation Service.
  - Agricultural Adjustment Administration.
  - Farm Security Administration.
  - Forest Service
  - Bureau of Plant Industry (Soil Survey).
  - Puerto Rico Agricultural Experiment Station.
- Department of Commerce:
  - Weather Bureau.

Insular agencies:
- Puerto Rico Planning Board.
- Department of Agriculture and Commerce:
  - Insular Forest Service.
  - Division of Ornithology and Pisciculture.
  - Division of Cattle Industry.
- Experiment Station (Rio Piedras and Isabela).
- Extension Service.
- Puerto Rico Water Resources Authority.
- Institute of Tropical Agriculture.
- Tobacco Institute.
- Land Authority.
- Treasury Department.

Private agencies:
- Agricultural associations.
- Sugar centrals.
- Labor unions.

This list is an outstanding example of the need for the consolidation (not simply "coordination") of all these government agencies and their subordination to one central policy-making board.

Potential productivity.—Puerto Rico must look toward the achievement of the maximum productivity capacity of its land, principally through more intensive practices, and in some cases through the application of artificial fertilizers.

The present productive capacity of all soils in the island has been estimated in the Soil Survey of Puerto Rico, published in 1942. These detailed ratings are by soil types for each of 17 major crops. They vary from a low of 5 to a high of 160, the latter in sugarcane; the standard of 100 set for a specific crop represents the largest yields in long-time production averages under current farming practices. For instance, on an experimental basis, land with a rating of 100 for sugarcane can be expected to yield 60 tons of cane, or nearly twice the present average yield for the island. In Puerto Rico, actually, the yield is known to have been as high as 96 tons to the cuerda on very fertile soil with scientific management and a high type of cane. The soil survey also gives each soil a general productivity rating, from 1, the lowest, to 10, the highest, estimated from the ratings for each crop grown or possible to grow on the soil. Reference has already been made to these ratings, which are helpful in securing a broad picture of the general productivity of the Island's land. Table 11 lists the land area in each rating.

It is evident that a great part of all land in the island is low in potential productivity. The areas rated 6 through 10, include 71.7 percent of the land.

However, production, at least in sugarcane, could be greatly increased, not by increasing the area devoted to the crop, but by restricting the area to the most suitable soils and working that area more intensively. A sample
study, using information on optimum yields given in the soil survey, showed that, if all but 4,288 cuerdas of the soils with a general productivity rating of 1 and 2—a net area of 170,560 cuerdas—were intensively grown to cane, the estimated total production of cane from that area could reach 11,000,000 tons, or 50 percent higher than the figure reported in the 1940 census of agriculture on 230,000 cuerdas. This figure was arrived at by taking for each soil in those two ratings the productivity in tons per acre assigned to it on the basis of experimental tests reported in the soil survey study, multiplying it by the number of cuerdas of each soil type, and adding the totals obtained for each. Productivity for the soils used ranged from a high of 140 tons to a low of 48 tons per cuerda, and the average yield for all was 66 tons per cuerda.

Since no area has been deducted here for buildings, roads, land lying fallow, or other necessary uses, and since uncertainties of climate and other factors have not been taken into account, the total production figure is probably too high. But even if the productive capacity of this area of 170,560 cuerdas were assumed to be reduced by 30 percent by such deductions, the possible production of sugarcane from it, under intensive practices, would still be equivalent to present production on a considerably greater area. In the case of coffee, it is the studied opinion of some agriculturalists that, if only the best soils are used, if only those slopes best protected from hurricanes are utilized, and if good farming practices are followed, the same quantity of
Development Plan for Puerto Rico

coffee now produced could be grown with a fairly constant annual production on 40 percent of the land at present used for this purpose. These discussions, of course, are intended only to indicate how far a combined program of land use and productivity intensification might possibly be carried. Similar studies could and should be made for other crops.

Figure 8 provides another rough measurement of possible increased production by comparing yields of various crops in Puerto Rico with production of the same crops in the United States. Such information shows that, with the exception of sugarcane, Puerto Rican yields are low. This is true no doubt because minor food crop cultivation has been restricted largely to less fertile soils. Further investigation of yields of similar crops in other Caribbean areas should be useful for judging the validity of such comparisons.

Under present war conditions, however, special consideration might also be given to applying improved farm practices to the production of food crops. If this is done by improvement of practices on land now in such crops, three things will result: (1) the total income from agriculture will be increased and so will per cuerda income; (2) more agricultural laborers will be able to find employment, for an increase in intensity of land use requires a proportionate increase in labor per cuerda; and (3) Puerto Rico will be able to reduce its dependence on outside areas for food stuffs. How far this expansion should be carried can only be ascertained by experiment. Certainly, it is true that much can be done with more intercropping, irrigation where it is available and not too costly, up-to-date cultivation methods, choice of varieties suitable for Puerto Rico, and greater application of fertilizers. Much also depends on a system of land tenure which will encourage the growth of a body of small farmers with an interest and a stake in their own land.

Finally, attention must be paid to a program for erosion control and soil conservation. Continued land depletion, coupled with continued population increase, is dangerous. In addition to damage caused by rains and hurricanes, there is damage resulting from continuous specialized use of arable land, from the type of crops at present cultivated on hillsides, and from present methods of cultivation. The problems faced by the Soil Conservation Service, which in cooperation with the Puerto Rico Reconstruction Administration, the Agricultural Experiment Station, and the Extension Service, has been developing and putting into operation a soil-conservation program in the island, can be resolved into four main points: (1) the reluctance of the individual farmer to abandon traditional tillage methods, and often his economic inability to do so; (2) lack of adequate funds and personnel by the agency; (3) difficulties of a very steep terrain, most of which in less densely populated parts of the earth would be left to forests or grazing; and (4) the lack of adequate information on desirable plant species and varieties. Possibly the small farmer's reluctance to abandon traditional methods could be overcome by an expansion of Government-run experimental or cooperative farms where the farmer could see concrete results of better practices, or by provision of credit by the Insular or Federal Government to carry through these practices. It is certainly true that if public work funds are to be available, there would hardly be a better use for them than the improvement of the Island's basic resource—its land—not only through soil-conservation programs but also through clearing of brush land and its conversion to more productive pasture.

Desirable changes in land tenure.—A discussion of desirable changes in land tenure tends to be more influenced by matters of opinion and human desires than either land use or productivity. In Puerto Rico there are two opposing schools of thought on land tenure. One holds that efficient use of the land requires its concentration in large blocks under single ownership, usually corporate, with the use of modern machinery and techniques in large-scale operation, with greater capital resources available, and economic ability to experiment with and develop more scientific varieties of plants. The other holds that this concentration, although admittedly efficient, has monopoly characteristics, gives economic power to a few out of all proportion to their actual investment, and works to the detriment of the political and economic situation of the farm laborers and independent farmers and also of the economic interests of the Island as a whole. In spite of these divergent opinions, it is patent that Puerto Rico must maintain, and where possible increase, its total agricultural productivity, that it must establish a larger proportion of its rural population directly on the land, and that concentration of ownership and concentration of management are two related, but different, things.

Away from the level cane lands, whose problem is discussed immediately below, tenure is much more widely dispersed. Coffee, tobacco, and minor crop farms are smaller and usually owned by the farmer who works them. In all of these, however, economic difficulties of recent decades have brought about a weakening of ownership through extensive mortgaging until, particularly in coffee, it could be said that the banks are the real owners of most of the farms. In 1934, a study of the mortgage debt situation for different crops revealed that 79 percent of the area of all coffee farms
was mortgaged and that the value of the debt averaged higher than the value of the farms. In these upland interior regions the farmer needs above all security of credit, information on substitute crops, better techniques of cultivation, and adequate marketing facilities. These measures can help to maintain a wider dispersal of tenure and fortify the base of this section of the agricultural economy.

It has been suggested that Puerto Rico's economic and social situation might be improved if certain changes in land tenure were adopted. For wherever the pressure on land is heavy, the basic ownership of that land has often conferred powers upon the holders which exceeded that attributable to the income from the land itself, and the landlessness of the rural masses has deprived them of any stable position in the community. The sense of security and responsibility which land ownership is considered to afford, it is argued, might effect profound changes in the attitude of the landless agricultural workers if they could be given their own land. Yet it should be noted that the average farm size in 1940 was only 34 cuerdas, so that additional commercial farmers could not be encouraged without reducing this low average still further. Even the provision of larger farms for present farmers, it has also been alleged, might in some cases reduce the operating efficiency of the larger unit. Yet the desire for land is very real in Puerto Rico; it was incorporated into the campaign slogan of one of the principal political parties at the last election. Fittingly enough, therefore, the Land Authority Act of Puerto Rico which was passed soon after the elections provided for the more equitable distribution of land, but in such a way as to overcome the objections cited. It did this (1) by setting up small acre lots for agricultural wage earners and (2) by providing for proportional benefit farms where it appeared unwise to divide the land itself. The Land Authority's program has been ably supplemented by that of the Farm Security Administration which has developed sound subsistence farms along with crops raised for cash income. It is to be hoped that these programs will encourage that growth of security and responsibility for which they were devised. If they do, they will become an important element in any planned development of the Island's human resources.

Special Problems and the Future

Sugar cane.—The special problems of sugar by-product manufacturing are discussed rather fully below under the Industries and Commerce section. The special problems and the probable future of sugarcane cultivation itself and of the processing of raw and refined sugar from it are relatively simple. Sugar is one of the world's most staple and most uniform commodities. Qualitative differences between even cane and beet sugars are nonexistent. In this respect, sugar is much more uniform than, say, wheat. On a free world market, sugar would be produced by those areas which could do so most cheaply, transportation to consuming centers being taken into account. Under these conditions, it is apparent that Puerto Rico would not be able to compete with many other places better adapted to sugar cultivation or employing cheaper labor; but neither would continental beet or sugarcane areas. Almost all major countries of the world have, however, adopted one method or another to guarantee their own supplies of this basic commodity, even if the consumer has to pay for this protection by higher prices. The production of sugar has become, thereby, as much a political as an agricultural or even economic problem. The United States has protected its own beet sugar and off-shore cane sugar supplies by quotas as well as a tariff; so that Puerto Rico is able to compete successfully, though at somewhat lower wage rates, with other United States producing areas and even with Cuba. If restrictions should be generally lowered, however, first Louisiana and then Puerto Rico and Hawaii together, followed by the Philippines and finally Cuba would, in that order, lose part of their market. The problem of sugar production throughout the world is basically political rather than economic.

From a more local point of view, the question of productivity and protection also enters into farm management arrangements and land tenure. Any change in ownership and, by implication, in control should not be confused, however, with the technical management of farm and milling processes. The latter ought to be maintained at as high a level of efficiency as possible compatible with whatever redistribution of ownership and control is deemed necessary. Land ownership and management in the sugar cane industry might possibly be rationalized in the following manner: (1) Each sugar central claims that it must have for its efficient operation a certain amount of cane land under its own management to cushion mill operations during the grinding period; in any case it must have the assurance based on ownership, agreement, or government control of a stable supply of cane; (2) The remaining areas of fertile soils should continue to be operated in large blocks with the best techniques available and with maxi-

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9 With the possible exception of Florida.
10 Based on same relative costs as 3-year average, 1930-32. See U.S. Tariff Commission, Report, No. 73, 3d Series, 1934. No cost data for beet sugar production are available; these costs, however, are probably higher than any for cane production.
11 The Insular Government recently extended the public utility concept by law to include sugar mills and their relation to sugar farmers. The development of control under this legislation may satisfy technical milling needs without requiring large areas of "administration" cane.
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Coffee.—Unlike sugar, coffee is highly distinctive, each coffee-producing area of the world possessing an individual type. It is also relatively competitive, for countries in the temperate belts can produce no substitutes which they might try to protect by tariffs or otherwise but must compete in buying their entire supply from the tropics. Puerto Rico also suffers from its relatively small output of coffee, its relatively high ship, as a proportional benefit farm, or on a cooperative basis. (3) Some cane land might conceivably be divided into family-size farms if its topography and other physical characteristics would technically permit this.

Tobacco.—Tobacco of the cigar-filler variety, type 46, is the second most important single crop in Puerto Rico, whether measured by value of production or of exports. Like coffee, the tobacco economy in Puerto Rico suffers basically from low per acre yields, an uncertain market, and lack of scientific farm management.

During the thirties the average yield in Puerto Rico was 651 pounds per acre and the average farm price 17 cents per pound. (A yield of 900 pounds per cuerda is considered high, although in some cases it may be as high as 2,000 pounds.) The record peak price was 52 cents in 1920, and since that year the trend has been downward. In 1940 it was 14 cents. Type 45 filler tobacco grown in Georgia and Florida shows yields significantly higher than Puerto Rico, 960 pounds per acre in 1939 and an estimated 1,257 pounds in 1940, but its price has been consistently lower than that of Puerto Rican tobacco with the exception of 1940, when it brought 14.9 cents. Lower average yields in Puerto Rico than in the United States can be expected, for much of the land used for tobacco cultivation in the Island is steep and lower in fertility than the level valleys of Georgia or Florida. The initial disadvantages of topography and fertility can be balanced to some degree by taking advantage of irrigation where available, and by using better seed varieties and fertilizer analyses adapted to the mineral content of the soil.

Increased yields and a better class crop, however, will not affect the conditions in the United States market. The demand for and the price of cigar-filler tobacco has declined with the trend in the United States from high- to lower-priced cigars and from cigars to cigarettes. In 1932 only 22 percent of Puerto Rico's tobacco was used in cigars which sold for 5 cents or less. In 1937 that proportion had risen to 70 percent.

In the case of tobacco, greatest improvement would come from increasing yields by better management and improving marketing mechanisms. The first approach has been presented above for other crops and for agriculture as a whole; it is basic in any place where the pressure of population on the land is as great as it is in Puerto Rico. Farming cannot only be a "way of life" under these conditions; it must also be a serious business to which scientific methods have to be applied.

To increase yields, more attention must be paid to erosion and greater care taken in selection of cigar varieties and in the preliminary phases of curing. It is not considered feasible at this time to try to switch

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29

Ref: Agricultural Experiment Station, Annual Report, 1940-41, Rio Piedras, P. R., p. 26.
to cigarette type of tobacco nor to manufacture cigars in Puerto Rico for export. The second approach is particularly important in tobacco; for there are no standard grades nor an inspection service to protect the farmer in selling his product and assuring uniform prices, and tobacco crops are grown on a large number of small farms, the farmer usually selling to a "refaccionista." Three profits are made by the refaccionista. One on the direct loan of money; one on the purchase of the tobacco; and one on the supplies sold the farmer. Lack of capital is thus operating against the welfare of the farmer. The Federal Government's short-term credit agency, in cooperation with the Puerto Rico Tobacco Marketing Association (a cooperative), has been successful in circumventing the refaccionista for about one-fourth of the tobacco crops, and further encouragement should be given to strictly supervised and audited tobacco cooperatives.

Cotton.—The cotton grown in Puerto Rico is of a very high-quality, long-staple variety, known as Sea Island cotton. The area devoted to this crop has varied greatly in response to the rise and fall of prices in world markets, but recently its importance as a cash crop has increased, owing to greater demand in the United States for long-staple cotton for specialized uses. It is estimated that at the present time 12,000 cuerdas are devoted to cotton on the Island, 7,000 cuerdas of which are on the south coast where cotton has been expanding, owing to favorable soil and climatic conditions. In 1940 the United States imported 11,000,000 pounds of long-staple cotton. Puerto Rico's production in that year was only about 667,000 pounds of lint at an average yield of 171.6 pounds per cuerda. Puerto Rico could supply a larger proportion of United States long-staple cotton imports by increasing the cultivation of this crop. If a portion of the land now being devoted to pasture and cattle ranges were planted to cotton, it would be possible to devote a maximum of 20,000 cuerdas to this crop. This area could produce 3,400,000 pounds of lint, equivalent to a third of the United States imports in 1940. At 1940 prices, 34 cents per pound, this crop would represent a gross value of $1,144,000 to Puerto Rico.

The future of cotton cultivation is promising. Yields are high, the cultivation of the crop furnishes a large amount of employment, and the export market appears favorable. The only serious obstacle to the cultivation of cotton is the pink bollworm, a pest that is difficult to eradicate, for the worm has many host plants on the island. Constant effort will be necessary to control this pest, including burning of affected cotton fields and control of the host plants in the vicinity.

Other crops.—Emphasis has here been placed on increasing the intensity of production on land now devoted to staple crops—sugar, coffee, tobacco, cotton—and to livestock. (See section on present land use.) But because all of these have special problems as in Puerto Rico and because the net yields per acre for at least coffee and tobacco will even under the best of conditions be low, emphasis in study and in actual production should be given to new crops which would be peculiarly adapted to Puerto Rican conditions and therefore either able to supply the local market, compete successfully in the world market, or command satisfactory prices in the continental United States market. The need has been presented in these terms:

What is needed above all in Puerto Rico is new hill crops. They exist now in the experiment stations; but they need to be brought to what, in industrial research, is called the pilot-plant stage. Quinine, teak-wood, the mahoganies, various grapes, certain bamboos which are resistant to termites, many plants which bear essential oils and others which are the source of insecticides, improved citrus varieties, certain promising fiber plants—these and many others need to be planted now on the thousand-acre scale. Among them will be found . . . what is needed: substitutes for the tobacco and coffee which are declining, the one because of erosion, the other because of hurricane damage and market failure.

Crops which may have some possibilities are: 18

Ylang-ylang for essential oil.
Lemon grass for essential oil.
Coffee for essential oil.
Bay for bay oil.
Soy beans for food, feed, fodder, and oil.
Derris for rotenone insecticides.
Flowers such as the combretum for shipment to New York.
New varieties of vegetables for the United States winter market.

Yet it should be recalled that the market for many of these products is limited. For instance, the total value of all imports of citronella, lemon, and lemon grass oil into the United States in 1939 was $1,139,000 and the total value of imported hardwoods and Philippine mahogany was only $1,771,000. In addition to the valuable research already performed by the Federal and Insular Agricultural Experiment Stations in Puerto Rico in connection with these and other "speciality" crops, it is desirable, indeed absolutely essential, that the economics of their production and marketing be investigated before farmers will be ready to turn to them.

17 R. G. Tagwell, Changing the Colonial Climate, San Juan, Puerto Rico, p. 69.
18 Suggested by Annual Reports of the Puerto Rico Agricultural Experiment Station at Mayaguez and of the Insular Experiment Station at Rio Piedras.
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**Forest Resources**

Except for the extensive coffee areas, where the relatively small shade trees form a green canopy over the delicate coffee trees, a heavily timbered, luxuriant forest growth, usually associated with tropical areas, does not exist in Puerto Rico. Inevitably the pressure of population on land has left only relatively small areas in forests. Although these are lower-yield lands, some tree species fortunately do not require good soils and can be planted on poor sites. In addition, where the productivity of agricultural land has declined below the point of marginality because of disastrous soil erosion, a small additional acreage could well be put into forest use. A third type of land available for forest production is that composed of small gores and bits of land interspersed throughout crop and pasture land where thick-growing clump varieties of trees such as bamboo or high-value individual hardwood trees such as mahogany can be grown.

The following data summarize the present forest situation:

<table>
<thead>
<tr>
<th>Cuerdas</th>
<th>Cuerdas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total land area of Puerto Rico</td>
<td>2,955,689</td>
</tr>
<tr>
<td>All land in farms</td>
<td>1,885,874</td>
</tr>
<tr>
<td>In wooded pasture</td>
<td>132,993</td>
</tr>
<tr>
<td>In woodland</td>
<td>181,911</td>
</tr>
<tr>
<td>In coffee</td>
<td>181,106</td>
</tr>
<tr>
<td>Land not in farms</td>
<td>369,815</td>
</tr>
<tr>
<td>In National Forests</td>
<td>31,440</td>
</tr>
<tr>
<td>In Insular Forests</td>
<td>55,709</td>
</tr>
<tr>
<td>Total areas in cuerdas (including coffee)</td>
<td>353,159</td>
</tr>
</tbody>
</table>

The Caribbean National Forest—Luquillo and Toro Negro units—comprises the area held by the Federal Government, while the forest under the jurisdiction of the Insular Forest Service are in scattered units mostly at lower elevations, Mona Island being the largest. There are surprisingly few data, particularly for Insular forest units, regarding actual quantity of marketable timber by types existing in these forest preserves.

With such a comparatively small area available for forest use, intensive development is indicated, for existing forests can be made much more productive by selective cutting to remove the least valuable species and poorly formed trees and by allowing the remaining trees to appreciate in value. The development of a maximum forest production program should stress the larger forest products such as poles, railroad ties, and lumber, and consider charcoal production as a byproduct for the use of inferior stems. While a longer wait is required for such products, this is justified by greater economic returns resulting from the higher prices they bring on the market. It has been found that under this practice charcoal production does not suffer so much as might be expected and that gross forest yields are increased. Deforested areas should be replanted with quick-growing species suitable for local uses on farms, such as fence posts, house posts, tool handles, ox carts, fuel, and charcoal. Particular attention should be given to reforesting water-shed areas above dam sites under a government-controlled program to retard erosion and consequent siltation of reservoirs.

It is estimated that 500,000 cords of wood are consumed annually in Puerto Rico for charcoal, stakes, posts, and poles; that 1,000,000 board feet are used annually by the existing furniture industry of Puerto Rico; and that about 100,000,000 board feet are imported annually for building material. Wood for furniture and building is now almost entirely imported; but it is estimated that the total requirements for charcoal, stakes, posts, and the like, could be met locally, and, that, if properly organized, about 1,000,000 board feet for furniture making could be secured annually from private forests levels and 500,000 board feet annually from Federal and Insular Forest Units. Although suitable timber is not as a rule easily accessible and the cost of exploitation would certainly be high, it should not be prohibitive under present conditions. Wood for construction purposes, however, can presumably never be secured from local resources.

**Mineral Resources**

It is even more difficult to evaluate the mineral resources of Puerto Rico than its forestry resources, for they have never been thoroughly explored with modern techniques and methods. It is known that the wide variety of minerals shown in table 12 occur, but there is a great deficiency in the data relative to their composition and geology.
### Table 12.—Mineral resources of Puerto Rico

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Location</th>
<th>Amount of deposit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silica sands</td>
<td>Scattered deposits along the north Coastal plains.</td>
<td>Adequate</td>
<td>Suitable for manufacture of glass products.</td>
</tr>
<tr>
<td>Manganese</td>
<td>Adjuntas</td>
<td>Unknown</td>
<td>Development appears feasible. Development apparently not feasible.</td>
</tr>
<tr>
<td>Lears</td>
<td>Adjuntas</td>
<td>Unknown</td>
<td>These deposits contain a high percentage of silica.</td>
</tr>
<tr>
<td>Mauins</td>
<td>Adjuntas</td>
<td>Large deposit</td>
<td>Generally low-grade ore.</td>
</tr>
<tr>
<td>Juanas Diaz</td>
<td>Adjuntas</td>
<td>Unknown</td>
<td>This deposit has been mined but at present operations are stopped.</td>
</tr>
<tr>
<td>Aguada</td>
<td>Adjuntas</td>
<td>Small veins or lenses</td>
<td>Good-grade ore but not feasible of development because of small deposits.</td>
</tr>
<tr>
<td>Iron</td>
<td>Arroyo</td>
<td>Unknown</td>
<td>Hematite ore.</td>
</tr>
<tr>
<td></td>
<td>Juncos-Humacao</td>
<td>Unknown</td>
<td>Magnetite ore.</td>
</tr>
<tr>
<td></td>
<td>Las Menas</td>
<td>450,000,000 tons</td>
<td>Magnetite ore similar to but probably inferior to Mayori deposits in Cuba. Ore contains 1.5 percent chromium and 1 percent nickel.</td>
</tr>
<tr>
<td>Kaolin</td>
<td>Ponce</td>
<td>Unknown</td>
<td>Appears favorable for use in manufacture of cement.</td>
</tr>
<tr>
<td>Gypsum</td>
<td>Between Cumberio and Cidra.</td>
<td>100,000 tons</td>
<td>Appears to be a good deposit.</td>
</tr>
<tr>
<td>Bentonite</td>
<td>Juana Diaz</td>
<td>Unknown</td>
<td>Low grade.</td>
</tr>
<tr>
<td>Pottery clay</td>
<td>Trujill Allo</td>
<td>Unknown</td>
<td>Scattered deposits are suitable for use in manufacture of pottery, brick, and tile.</td>
</tr>
<tr>
<td>Limestone</td>
<td>Various</td>
<td>Small</td>
<td>Deposits are suitable for use in manufacture of fertilizers and cement.</td>
</tr>
<tr>
<td>Marble</td>
<td>Rio Piedras</td>
<td>Adequate</td>
<td>Material is suitable for construction of floors, stairways, and ornamental architectural designs.</td>
</tr>
<tr>
<td>Copper</td>
<td>Various</td>
<td>Small</td>
<td>Adequate</td>
</tr>
<tr>
<td>Lead</td>
<td>Various</td>
<td>Unknown</td>
<td>Adequate</td>
</tr>
<tr>
<td>Zinc</td>
<td>Unknown</td>
<td>4 x 1 miles</td>
<td>Adequate</td>
</tr>
<tr>
<td>Gold</td>
<td></td>
<td></td>
<td>Adequate</td>
</tr>
</tbody>
</table>

**Remarks:**
- Suitable for manufacture of glass products.
- Development appears feasible.
- Development apparently not feasible.
- These deposits contain a high percentage of silica.
- Generally low-grade ore.
- This deposit has been mined but at present operations are stopped.
- Good-grade ore but not feasible of development because of small deposits.
- Hematite ore.
- Magnetite ore similar to but probably inferior to Mayori deposits in Cuba. Ore contains 1.5 percent chromium and 1 percent nickel.
- Appears favorable for use in manufacture of cement.
- Appears to be a good deposit.
- Low grade.
- Scattered deposits are suitable for use in manufacture of pottery, brick, and tile.
- Deposits are suitable for use in manufacture of fertilizers and cement.
- Material is suitable for construction of floors, stairways, and ornamental architectural designs.

### Rainfall Map of Puerto Rico

**Source:** USDA Soil Survey of Puerto Rico

**Figure 8**
From these data, it appears unlikely that Puerto Rico can depend upon mining to absorb more than a small number of its working population. Yet Puerto Rico is so urgently in need of alternative resources and opportunities for employment that the feasibility of developing mining enterprises deserves thorough and immediate attention. It is specifically necessary to know if these minerals are present in commercial quantities, if they are of commercial grade, and to what extent they can be developed.

**Water Resources for Agriculture**

Over those portions of the Island which enjoy sufficient rainfall, the special water resources problems, such as erosion control, prevention of reservoir siltation, and flood control on a few rivers, are only incidentally agricultural. But some parts of Puerto Rico are quite dry, annual rainfall reaching as low as 25 inches, which is extremely small when the showers are frequent and of light intensity and the rate of evaporation is high. (See fig. 8.) Along the south coast particularly and also in parts of the west and northwest coastal plains, irrigation is vital to the growing of sugarcane. (See fig. 9, p. 46, for location of irrigation districts.) Although generally 4 acre-feet per year is adequate, some areas on the south coast where the soils are highly permeable actually require several times that amount for good irrigation. About 78,000 acres are now irrigated in Puerto Rico.

There is a need for scientific determination of the optimum irrigation water required for sugarcane and other crop production and for finding new crops that can pay the cost of their irrigation, for at present sugarcane is the only crop of any importance that can do so. More extensive hydrologic data are also needed—particularly accurate rainfall records, and the range of each observation station.

In addition to surface water, the coastal plains generally are dependent upon ground water as a source of supplemental supply for both irrigation and domestic use. On the south coast, the underground water-bearing strata are sand and gravel, from which abundant supplies of water are available; on the north coast, they are generally of limestone formation, yielding a less plentiful supply. On the west coast, proving a well is uncertain and on the extreme easterly end of the Island little if any water can be obtained from deep wells. Fair quantities of water have been secured from wells in the vicinity of the interior towns of Aibonito and Cayey. Much stream flow is now wasted into the sea. A method of water conservation untried in Puerto Rico but used with excellent results in the Santa Clara Valley and southern coastal plain of California, is the practice of storing unused stream flow underground by distributing it over porous spreading areas. Necessary investigations of the water infiltration capacity of the coastal plains do not appear to have been made and should be initiated at once.

**Specific surveys.**—To facilitate the development of water resources for agriculture, the following types of surveys should be made.

- Analysis of existing hydrologic data on rainfall, run-off, stream flow, and river profiles.
- Collection and analysis of hydrologic data on (1) evaporation, and (2) quantity and quality, as well as location and extent, of underground water supplies.
- More extensive field experiments to determine most efficient use of irrigation water in Puerto Rico for various irrigable crops.
- Investigation of the probabilities of salt-water infiltration from the ocean into underground supplies on coastal plains, followed if necessary by legislation prohibiting pumping of overdrafts on ground-water supplies.
- Completion of comprehensive field surveys now under way by the Puerto Rico Water Resources Authority to locate all potential dam sites, followed by geologic and economic studies to determine the feasibility of their development to provide for storage reservoirs for irrigation and hydroelectric power generation.
- Investigations to determine the origin, movement, and deposition of silt in Puerto Rico, and the effects of forests, other types of vegetal cover, terraces, and crop rotations in controlling run-off.
- Continuation of investigations now under way by the Puerto Rico Water Resources Authority to determine the feasibility of developing the Quebradillas-Camuy-Hatillo irrigation project and to further the possibility of the Manati-Vega Baja project to irrigate 7,500 acres and develop electric energy, and the Lajas Valley Project.
- Continuation of investigations now under way by the Water Resources Authority leading to the development of the water resources of the Añasco, Arecibo, and Loíza River drainage basins.

**Industry and Commerce**

*General Problems*

*Protection and competition.*—The economy of the Caribbean islands has always been based upon agriculture and for the most part upon one crop—sugarcane. This plantation crop required a large, cheap labor force...
but the quantity of this labor force on most of the smaller islands, through uncontrolled population growth, increased at a rate faster than the employment opportunities in the one-crop agriculture. In fact in some islands the labor force increased while employment opportunities showed a real decrease. Since the depression we have relearned that labor and other elements of production are sources of wealth even if they may be "marginal" from a strictly economic point of view. It is increasingly held that any social community should use its labor and other resources to the utmost in the production of goods and services and that unemployment relief is more costly to the community as a whole than semi-subsidization through various social and governmental controls.

The application of a closed economy to an island such as Puerto Rico is particularly fraught with problems. To base Puerto Rico's economy on anything but sugar-cane as the export crop, is to bring about a lowered standard of living, since no other use of land can hope to yield comparable returns in goods and services. Yet an exporting country is dependent on the maintenance of free-trade principles and cannot hope only to give and take. This must be especially true of Puerto Rico in its politically and economically dependent position vis-à-vis the Continental United States, since Puerto Rico's consumer market, although a small one, offers a special outlet for the odds and ends of the highly industrial continental mass production. Mass production implies not only articles of standardized and uniform shape, size, and quality; it implies also a small percentage of nonuniform units, surplus productive capacity, and constantly changing styles. But such surplus products or byproducts cannot be sold in the home mass-consumption market without weakening the price and standard structure so laboriously built by advertising. Puerto Rico, however, would and normally does offer such a market outlet where, at a price, surplus packs of canned vegetables or fish, surplus cuts of meat such as pigs feet or ears, seconds in textiles, or end-of-season styles of shoes will be taken.

Up to a certain point this exchange of goods is mutually advantageous to both communities. But the amount of land in Puerto Rico (and therefore employment) which can be used for sugar production is physically limited and the amount of Puerto Rican sugar that the Continental United States will consume is politically limited. Under these circumstances the employment opportunities for Puerto Rico's expanding labor force are restricted as far as the use of local physical resources are concerned, and will continue to be restricted with the result that the continental community through relief outlays must, in a sense, come to subsidize its markets for its own surplus products.

There are other areas in the world with population densities comparable to Puerto Rico, but those primarily dependent on an agricultural land base have a living standard lower than Puerto Rico. Those that have raised their standards have done so through industrial or service development, but this industrial activity was grounded upon advantageous location of natural resources (forest, mineral, agricultural, energy) or advantageous location as to existing markets and trade routes. Puerto Rico has few if any of these resources. It has no forests or minerals to speak of; it has no excess cheap power; its agricultural land is already used to its full limit and is producing the most favorable crop as to acreage and cash yields. It is at present on no great trade routes although, as discussed later in this report, the development of the airplane may alter this to some extent.

Puerto Rico therefore has no reason to become an industrial center other than its large surplus of labor, its hands willing to work. But it is highly questionable whether Puerto Rico can, in a peacetime, freetrade economy, build any sizeable industry to compete on a price basis with surplus products of the continental community. Because of this competitive position, wage levels in Puerto Rico probably must continue to be lower than on the continent. Yet, on the other hand, if Puerto Rico were to develop a closed autarcie industry it would run the risk of losing its preferential treatment in regard to sugar. Specifically, could Puerto Rico hope to increase the value of its industrial production by the $16,500,000 it would lose if it were required to compete on the same sugar tariff basis as Cuba or the $33,000,000 it would lose if it were to compete on the same sugar tariff basis as the Dominican Republic? According to the Census of Manufactures of 1939 the total value of products of manufacturing industries in Puerto Rico (exclusive of raw and refined sugar) was $43,600,000 and the total value added by manufacture was $16,500,000.

It is this dilemma that has occasioned the stress laid in this Development Plan on the necessity of stabilizing the political status of Puerto Rico. It is true, of course, that Puerto Rico has developed some industries without a rationalization of these relationships. It is true that other industries can be developed without such rationalization, but the fuller use of Puerto Rico's labor resources is intimately connected with its relationship to the United States and the world. It may

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21 Both figures based on 1941 production and tariffs. Both tariff and production changes in 1942 can be attributed to particular war circumstances.
Development Plan for Puerto Rico

well be that in monetary terms the present arrangement is preferable both for Continental United States and for Puerto Rico, but on the other hand it may also be that, at whatever cost, only a usefully and productively engaged population can develop these fundamental social disciplines, adjustments, and responsibilities necessary to bring population and resources into balance.

In terms of industry, for the economic well-being of the Island a stabilization of the political status might reasonably be included: (1) a sugar quota of 1,000,000 tons (raw value) fixed for a period at least equal in length to the now 45-year period of dependence in which the present sugar economy developed; (2) a full local processing of this sugar quota by allowing it to be imported into the States in refined form; and (3) the continuance of the present arrangement of returning to Puerto Rico the United States excise tax on Puerto Rican rum whose value would depend upon the Island’s own ability to produce a superior product which would meet continental consumer demands in the highly competitive distilled-liquor market. Apart from this, Puerto Rico must make the choice as to whether it is more desirable for it to protect its “potential” home industry against outside competition by various means of import controls or to concentrate on export industries in which it may have or may develop peculiar advantages which will allow it to compete in free world markets. The choice is, of course, not a completely clear cut one, but the factor of policy must enter into any sound decision as to the final feasibility of many of the individual industries mentioned in the subsequent discussions.

Table 13.—Employment in manufacturing industries, value of products, and value added by manufacture, Puerto Rico, 1909, 1919, and 1939

<table>
<thead>
<tr>
<th>Item</th>
<th>1909</th>
<th>1919</th>
<th>1939</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All manufacturing</td>
<td>Manufacturing other than sugar milling and refining</td>
<td>All manufacturing other than sugar milling and refining</td>
</tr>
<tr>
<td>Persons employed</td>
<td>18,122</td>
<td>12,224</td>
<td>18,454</td>
</tr>
<tr>
<td>Value of products</td>
<td>$39,749,742</td>
<td>$16,380,354</td>
<td>$33,900,634</td>
</tr>
<tr>
<td>Value added by manufacture</td>
<td>515,296,134</td>
<td>315,900,770</td>
<td>55,371,776</td>
</tr>
</tbody>
</table>

1 Excludes home workers engaged in contract needlework.

Source: Census of Manufactures.

Trends.—During the 30-year period from 1909 to 1939 the number of persons engaged in manufacturing industry increased 47 percent, the value of products 201 percent and the value added by manufacture 131.1 percent, but a large proportion of this activity was attributable to the sugar grinding and refining mills. The comparative figures for the ceasuses of manufacturing industries taken by the United States Department of Commerce in 1909, 1919, and 1939 are given in table 14, both including and excluding sugar milling and refining.

Home workers engaged in contract needlework are not included in the wage-earner figures above and must really be added to secure the total number of persons gainfully employed in manufacturing activity in 1939 only, since no needlework at all was reported in the earlier years. The value of home needlework production is, however, included in “value of products.” Home needlework employment is very difficult to measure, and it is the source of much confusion regarding Puerto Rico’s employment and unemployment figures. Although the 1940 Census of Population, as distinct from the 1939 Census of Manufactures, gives a figure of 46,217 engaged in home needlework, this overemphasizes the importance of the industry in the Island’s economy. Employment is extremely sporadic; persons may be counted as employed while they are merely waiting for the subcontractor to come along and pick up and pay them for their finished “bundle”; wage rates

Table 14.—Persons engaged in manufacturing, Puerto Rico, 1939, exclusive of sugar milling, sugar refining, and needlework

<table>
<thead>
<tr>
<th>Industry</th>
<th>Number of wage earners employed</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bread and other bakery products</td>
<td>400</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Furniture and furnishings</td>
<td>400</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Printing, publishing, and allied activities</td>
<td>100</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Machinery</td>
<td>90</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Tobacco manufactures</td>
<td>400</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Liquors, distilled</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Liquors, rectified or blended</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Tobacco products and other fiber manufactures</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Canned fruits and vegetables</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Food, manufactures</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Fertilizers</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Vermicelli, soil paste, and noodles</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Metal products</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Floor and wall tile (except quarry)</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Plaster—mill products</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Beverages, nonalcoholic</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Lure</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Perfumes, cosmetics, and other toilet preparations</td>
<td>300</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Drugs and medicines</td>
<td>250</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Leather and leather goods</td>
<td>250</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Brick and hollow structural tile; sewer pipe; other concrete and stone products</td>
<td>250</td>
<td>38,877,773</td>
</tr>
<tr>
<td>Woods</td>
<td>47</td>
<td>122,256</td>
</tr>
<tr>
<td>Candy, chocolate and cocoa</td>
<td>25</td>
<td>122,256</td>
</tr>
<tr>
<td>Ice cream and ice cream</td>
<td>72</td>
<td>122,256</td>
</tr>
<tr>
<td>Jams, jellies, and preserves</td>
<td>6</td>
<td>45,658</td>
</tr>
<tr>
<td>Cigars</td>
<td>54</td>
<td>30,241</td>
</tr>
<tr>
<td>Other industries</td>
<td>22</td>
<td>16,735</td>
</tr>
</tbody>
</table>

Total: 7,449 $23,533,408

Source: Census of Manufacturers, 1939.
at about 121/2 cents an hour are low; and the total value of needlework products exported in 1940 was only $9,621,647 (a marked decline from 1939), which includes the cost of the basic imported silk and other textile materials.

Of the 26,700 engaged in manufacturing industry as listed by the 1939 Census of Manufactures, 10,700 were engaged in sugar mills and refineries, and of the total value of manufactured products of $111,500,000, these industries accounted for $68,000,000. Similarly, 6,800 were engaged in factory needlework and the total value of products of this industry was $21,000,000. Thus all of the remaining manufacturing industries accounted for only 31 percent of the persons engaged and 28 percent of the value of products. The major industries other than sugar and needlework are listed in Table 14 in order of the number of wage earners employed.

Labor force and skills.—It took many years to build up the individual industries listed in Table 14 and to train the workers, yet it is estimated that every year the net addition (approximately 10,000) to the labor force because of normal population growth is more than equal to the total engaged by all these other industries. In view of this net annual labor force increase and the large reservoir of unemployment and part-time employment, the magnitude of the problem of gainful occupation for Puerto Rico's population is obvious, although the proportion of the employable age group which was actually employed, according to the 1940 census, is almost identical with that of the Continental United States. The employment status of the labor force is indicated in Tables 15 and 16.

Definitive studies measuring the relative efficiency of this labor force in comparison with workers in Continental United States or elsewhere in the world are needed but lacking. Without any scientifically controlled surveys, there will naturally be wide divergence of personal opinion on this subject. Whatever differences do exist, the productivity and efficiency of Puerto Ricans as compared to workers elsewhere may be attributable to a number of different factors: to the lower diet standards; to the prevalence of tropical diseases, especially the debilitating hookworm; to the possible enervating factors of continually warm, but not hot, tropical climate; to the lack of tools and experience with industrial techniques and disciplines; to established patterns of part-time and seasonal employment; or to basic cultural attitudes which react only slowly to the impact of modern conditions. The required period of training may be somewhat extended, which is only natural because of the lack of opportunities for familiarity with industrial skills; but workers once trained are found to be extremely adept. There appears to be an inherent adaptability to delicate precision work not only among women but also among men. This is perhaps the reason why such types of industry as needlework, sorting operations of various kinds, petty point, cutting of jewel bearings, button production, and fine rug making have been particularly successful in Puerto Rico.

Factors affecting new capital investment.—In the search for new industrial developments in Puerto Rico, it must always be remembered that the economy of the Island will probably always be based primarily on sugar, which is not only Puerto Rico's main agricultural crop but is also its main manufacturing and chemical industry with its huge cane-crushing mills and its clarification and crystallization vacuum pan apparatus.
Development Plan for Puerto Rico

Since the time of the American occupation, Puerto Rico has been under the protection of the United States tariff and therefore in a favorable position to compete against other sugar-producing areas for the United States market. It was only natural, therefore, that almost all available Puerto Rican capital would be poured back into the purchase of sugar land, into the improvement of that land by irrigation and intensive fertilization, and into the development of the extractive processes in order to get the last ounce of sucrose out of the cane. This was a tried and true money-making field; hence it could not be expected that capital from the same sources would be invested in other industrial activities of more doubtful outcome. However, the sugar quota system, initiated in 1935, limited sugar production and slowed this reinvestment process.

Particularly within the last decade there has been increasing discussion of establishing new industries; but, partly because of the reluctance to take risks where results were more uncertain, partly because of the economic uncertainties connected with possible changes in political status, and partly because of the fear of dumping on the part of competitive continental manufacturers, very few new enterprises were initiated. However, pressures of population on resources grew (in the form of unemployment), and various governmental agencies—both Federal and Insular—made industrial surveys, financed cooperatives, set up a large cement plant, and in 1942 established the Puerto Rico Development Co. The purpose of this public corporation, which has authority to issue up to $5,000,000 in bonds and which receives an annual appropriation of $500,000 from the Insular Government, is to bring about the development of new industries in Puerto Rico either by loans to private entrepreneurs or by itself engaging directly in manufacturing activity. The function of such a corporation should be in part to act as a pace setter, to take the first steps in the development of a new industry or the modernization of old industries. Whether this first step in every case is itself a great profit maker should not be

Table 17.—Analysis of more important Puerto Rican import groups, 1940-41, to suggest substitution by local production

<table>
<thead>
<tr>
<th>Category</th>
<th>Value (in millions of dollars)</th>
<th>Value of principal items (in millions of dollars)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Imports from the United States</td>
<td>Imports from foreign countries</td>
<td></td>
</tr>
<tr>
<td>Animals and animal products, edible</td>
<td>9.7</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Animals and animal products, inedible</td>
<td>5.1</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Vegetable food products and beverages</td>
<td>22.7</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Vegetable products, inedible</td>
<td>7.1</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Textile fibers and manufacturing</td>
<td>10.9</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Wood and paper</td>
<td>10.9</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Nonmetallic minerals</td>
<td>10.9</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Metals and manufacturing</td>
<td>17.2</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Machinery and vehicles</td>
<td>17.2</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Chemicals</td>
<td>9.6</td>
<td>1.1</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>4.7</td>
<td>1.7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>128.1</td>
<td>7.1</td>
<td></td>
</tr>
</tbody>
</table>

1 Discussied in further detail in appropriate section of the Development Plan.

Source: Data from Statistical Yearbook of Puerto Rico, 1940-41
the only criterion, if it has shown other entrepreneurs
the way the operation can be accomplished successfully
and profitably. Only by constant and energetic willing-
ness to try new fields will the full industrial potential
of Puerto Rico be realized. It should also be borne in
mind that, to attain this objective, capital now on the
Island must be induced to remain there and such outside
capital must be obtained as will not prove a detriment
to the Island’s welfare.

While the war has caused a shortage of industrial
materials, it has in a number of cases encouraged local
production because of the lack of competing continental
products. Military agencies, war agencies, the Depart-
ment of the Interior, and the Investigating Committee
under Senator Chavez, have assisted in the securing of
machinery priorities for some new industries—cement
and glass-bottle production, for example—since the
import shipping needs of the island are reduced to
the extent that the Island can substitute local for
“foreign” products. The initiation of these industries
while the markets for their products are secure should
assist them under more competitive conditions in the
post-war period. In this connection, some mechanism
to control “dumping” should be authorized by the
appropriate authorities.

Obviously there are certain industries which on a
theoretical basis will have a better opportunity to be
successful in Puerto Rico than others. There are indus-
tries over which Puerto Rico has some extra control;
they include industries which will produce products
consumed on the Island which are now imported and
those which will use raw materials produced on the
Island. Table 17 presents an analysis of imports by
products in the latest “normal” year, in order to review
those which might be substituted by locally manufac-
tured articles.

Table 18.—Summary of feasible industrial possibilities for
Puerto Rico

<table>
<thead>
<tr>
<th>Product</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish</td>
<td>$ 500,000</td>
</tr>
<tr>
<td>Meats and poultry</td>
<td>$ 3,000,000</td>
</tr>
<tr>
<td>Vegetables¹</td>
<td>$ 1,250,000</td>
</tr>
<tr>
<td>Fodder</td>
<td>$ 500,000</td>
</tr>
<tr>
<td>Sugar products</td>
<td>$ 1,000,000</td>
</tr>
<tr>
<td>Cotton, silk and rayon goods</td>
<td>$ 7,250,000</td>
</tr>
<tr>
<td>Jute bagging</td>
<td>$ 1,250,000</td>
</tr>
<tr>
<td>Wood products, furniture</td>
<td>$ 1,500,000</td>
</tr>
<tr>
<td>Paper products</td>
<td>$ 1,000,000</td>
</tr>
<tr>
<td>Stone and cement</td>
<td>$ 1,700,000</td>
</tr>
<tr>
<td>Glass</td>
<td>$ 1,000,000</td>
</tr>
<tr>
<td>Clay</td>
<td>$ 2,000,000</td>
</tr>
<tr>
<td>Metals and machinery</td>
<td>$ 500,000</td>
</tr>
<tr>
<td>Medicines and drugs</td>
<td>$ 1,000,000</td>
</tr>
<tr>
<td>Soap</td>
<td>$ 350,000</td>
</tr>
<tr>
<td>Bottle closures</td>
<td>$ 350,000</td>
</tr>
<tr>
<td>Total</td>
<td>$25,300,000</td>
</tr>
</tbody>
</table>

¹ Excluding beans and potatoes.
Source: Table 17.

It should be noted that a large proportion of the
products omitted from table 18 as being nonfeasible of
expansion are food products, the local production of
which is possible but not desirable economically, since
lands devoted to sugar yield higher exchange values.
It is also possible to make large substitutions of locally
produced yeast for presently imported food values as
well as to substitute vegetable fats from coconuts for
animal fats. But fundamental dietary habits and pref-
ferences are extremely difficult to change over short
periods of time. Such a wide gap now exists between
actual diet and adequate diet that a considerable time
would have to elapse before locally produced yeast and
vegetable oils could hope to make up the dietary gap.

The question of type of development, whether hori-
zontal or vertical, is also an important factor in invest-
ment. Curiously enough, while capital was being
turned back into the sugar industry in Puerto Rico it was
on a vertical development basis from plantation to mill
to (if possible) refinery. Great ingenuity was used in
developing new machinery and processes in order to
squeeze out the last sugar crystal. But the same in-
genuity was not used to develop the industry on a hori-
zontal basis through the development of potential by-
products, and through the manufacture of the materials,
other than cane, that are required by the sugar industry.

For example, the manufacture of rum from the impor-
tant byproduct of sugar, blackstrap molasses, was never
done as a part of the sugar-making process, using the
excess bagasse for fuel, but always as a separate oper-
ating requiring transportation of the raw material and
importation of the fuel.

It would seem desirable therefore as a first step to
develop both vertically and horizontally the sugar in-
dustry as the basic core of Puerto Rico’s economy. The
sugar quota system, which will undoubtedly be reestab-
lished after the war, will set the production level of
sugar cane for Puerto Rico, which will probably range
somewhere between 800,000 and 1,200,000 tons. It is of
course to Puerto Rico’s interest to obtain the highest
possible quota, although there will be many political
pressures from cheaper producing areas such as Cuba
and by continental beet and cane producers to secure
Development Plan for Puerto Rico

a larger share of the market at the expense of Puerto Rico. At any rate, the byproduct production capacity of the sugar mills and the consumption by the mills of raw materials other than cane could be determined with sufficient precision to plan the size of new industries dependent upon it.

Industries Based on Agriculture

Sugar.—On a tonnage basis, the byproducts of sugar production are larger than the primary product, raw sugar. On the average, the 2,000 pounds in a ton of cane yield 240 pounds in raw sugar, 500 pounds in mashed bagasse fiber (wet basis), and 90 pounds in filter press mud. The remainder is water except for approximately 5 gallons of end molasses per ton of cane. Much experimentation, particularly in the Far East, has been undertaken to determine the best uses to which such inevitable byproducts can be put. They do have value, although in some cases these values are marginal and find difficulty in competing in the market against other similar products. But even if such manufacturing processes had only a small margin of profit, they would still provide employment and their use would mean that local income could be spent for local production and processing instead of for imported products (and the foreign production costs involved therein). Some sugar byproducts, such as rum, when processed, can be sold in competition in overseas markets; some byproducts such as molasses can even be sold in their unprocessed state in such markets; some, like bagasse, can probably be sold only in a local market; and some, such as much of the filter press mud solids, probably have value only as they can be consumed by the local producing unit itself.

If we assume a probable average annual sugar quota of 1,000,000 tons of raw sugar for Puerto Rico it would mean that there would be available each year from 8,300,000 tons of cane, a total of 2,076,000 tons of mashed bagasse (wet basis), 373,500 tons of filter press muds, and 41,500,000 gallons of final molasses. Certain comments regarding possible industries in this field follow.

1. Sugar refining.—At present, because of war conditions, there are no quota restrictions on refining sugar in Puerto Rico and exporting refined sugar to the continental United States. However, because of the lack of the type of shipping needed for refined, rather than raw, sugar and perhaps because of other commercial pressures, the refining of sugar in Puerto Rico has not expanded. If this relaxation of restrictions on refining can be maintained after the war, considerable benefits should accrue to Puerto Rico. Offshore sugar-growing areas have for a long time agitated for the refining of sugar at the point of production, but it has been prevented by the political strength of existing refiners in the United States and the large unused capacities of their plants. There do not appear to be any sound technical reasons against refining at the point of production. The refining process only represents an extension of the raw-sugar production process. In fact, it is merely a matter of eliminating approximately the last 4 percent of nonsugars, representing the difference between raw sugar of 96° polarization and refined sugar of 100° polarization. Refining is, however, a highly mechanized industry. The Census of Manufacturers for 1939 reported only 14,133 wage earners in the whole United States cane refining industry, which handled about 4,404,000 tons of raw sugar. The 27 establishments involved had a total value of products of $333,877,000, with "value added by manufacture" of $55,993,000 including wages of $16,197,000. In the same year, in Puerto Rico, 4 refineries employing 1,971 wage earners handled about 180,000 tons of raw sugar, had a total value of products of $12,510,000, and $2,169,000 in "value added by manufacture" including $239,000 in wages. It will be noted that, whereas continental treatment of sugar was at the rate of 311 tons per worker, in Puerto Rico it was only 91 tons per worker. With the continuance of the same production per Puerto Rican worker, the local refining of an average crop yielding 1,000,000 tons of raw sugar would provide employment for about 11,000 workers. This is undoubtedly too high a figure, for continuous and full-scale operation would probably not provide employment for more than 5,000 to 7,500 workers. The capacity of present (1943) refineries in Puerto Rico could produce about 500,000 tons of refined sugar annually. It should be recalled, however, that the refining of the total crop would also cause some decrease in other employment such as bagging, trucking, stevedoring, etc., since the weight of refined sugar is about 7 percent lighter than raw sugar.

2. Candy Manufacture.—About $1,000,000 worth of candy products are imported annually into Puerto Rico. Since the main ingredient of these products is sugar, which can be secured locally, and chocolate and chicle, which can be secured from nearby Caribbean areas, it has been recommended that the production of candy products on the island be expanded. In 1939 the total value of locally produced candy was only $80,000 and employed only 42 wage earners. The figures of the Census of Manufacturers considerably underestimate actual employment and production, however, since a vast amount of candy is produced at home or in small kitchens and is not included in the census figures. The sale of these candies by street vendors continually fills the air with cries of "coquito."
3. Uses of bagasse.—The sugarcane stalk, after the juices are crushed out, comes out of the rollers in a pulverized form known as bagasse. As previously stated, the yield of bagasse on a wet basis is about 500 pounds per ton of cane, indicating that a sugar crop yielding 1,000,000 tons of raw sugar and requiring 8,300,000 tons of cane would also yield about 2,075,000 tons of bagasse (wet basis). All sugar mills use this bagasse as a source of fuel during the grinding season since it has, as fired, a heating value about one-half the value of a medium coal. It would appear, as discussed in the energy section of this report, that this use is the most desirable because of the cost of imported fuel oil in Puerto Rico, because of natural limitations on the development of hydroelectric power, and because in the long-term industrialization of Puerto Rico all local energy resources should be husbanded. However, there has been a surplus of bagasse above that needed to produce power for the sugar mills, which, if not otherwise disposed of, would have to be stored in waste piles and would represent a definite fire hazard. Under these circumstances the mills have burned in their furnaces a greater quantity of bagasse than was needed to produce the energy required. With a 1,000,000-ton crop of raw sugar, it is estimated that there would be an annual surplus of between 310,000 and 415,000 tons of wet bagasse or 15 to 20 percent of the total.

Much experimentation has gone into the development of profitable uses for excess bagasse. The most successful of these developments has been the production of fiberboard or wallboard for use in the construction industry. The Celotex Co. successfully operates a large plant (1,500,000 square feet per day) in Louisiana. Another plant is operated by a sugar company in Hawaii.

The value of producing construction and building materials in Puerto Rico, with its extremely low standards of housing, is self-evident. This insulating building board could be specially adapted for tropical use with more emphasis on water and insect resistance than on heat insulation. Experiments along this line by combining building board and asphalt have shown the product to be extremely resistant to weather and termites. It is therefore believed that operations in Puerto Rico should be concentrated on this type of product. This product would have especially favorable possibilities for large-scale export to other nearby tropical areas, for Puerto Rico is well located to secure asphalts from the Caribbean areas of Trinidad and Venezuela.

The Puerto Rico Development Co. is now negotiating for the construction of a plant to manufacture wallboard and other construction materials from bagasse. With a production capacity of 60,000 square feet daily (requiring about 14,000 tons of bagasse annually), the cost of the plant is estimated at about $800,000. It is believed that adequate labor skills exist in Puerto Rico, for less than 75 employees would be needed for the operation of the plant. Roughly, if Puerto Rico were eventually able to turn its full excess bagasse production to this purpose, employment for between 1,500 to 2,000 persons would be provided though, of course, it might take some time to establish a firm market for this total annual production and undoubtedly some of the surplus bagasse will be uneconomically located for use by the building board industry.

While in other sugarcane areas wallboard has to date proven the most successful commercial adaptation of bagasse, many other uses, such as the production of plastics, paper pulp, and dynamite fillers, have been suggested, all of which are in varying stages of experimentation. Particular study is now being given in Puerto Rico to the use of bagasse as a chemical pulp for paper making, which at present prices offers extremely favorable opportunities. The continuance of such prices in the post-war period and other factors relating to this highly competitive market require extended analysis. Before the war, Java was developing a bagasse charcoal industry. As large quantities of charcoal are consumed in Puerto Rico, this possibility should also be investigated. The ash of bagasse contains considerable amounts of potash which could possibly be adapted for use as an alkali in glass making and in fertilizer. Bagasse combined with molasses has been successfully tried in certain of the British West Indies for animal feed and, since Puerto Rico requires large quantities of feed, this offers yet another possible use for surplus bagasse.

4. Uses of filter-press muds.—Filter-press mud is the sediment obtained in the sugar manufacturing process when the raw juice is treated with lime. While this mud has a number of values, cost of production and available market studies are required. As much as 17 percent of this filter-press mud has been discovered to consist of the wax formed in the rind of the sugarcane stalk. This wax can be used in varnishes and shoe polishes. Other less important suggestions have been for the reconversion of the mud into quick lime and the recovery of sulphur. When combined with bagasse or molasses, this mud residue can contribute some fertilizer value.

5. Uses of molasses.—The highest monetary value of final molasses is in the production of alcohol, notably potable alcohol in the form of rum. Rum is a high-value product which has become increasingly important in Puerto Rico's export trade. According to the Census of Manufactures of 1939, only 656 wage earners were employed in Puerto Rico in the alcoholic beverage industry. But since that time production of rum has more
than tripled, being 6,900,000 proof gallons during the fiscal year 1941–42. The assumed annual yield of 1,000,000 tons of raw sugar would yield 41,500,000 gallons of molasses. Since 2½ gallons of molasses produce 1 gallon of 190-proof alcohol, which in turn is equivalent to about 2 proof gallons of rum, a total potential rum production of 33,200,000 proof gallons is indicated or about 5 times the present production. On the basis of the present employment ratio, this could provide employment for 10,000 wage earners. A decided advantage to Puerto Rico is that the United States beverage tax on rum exported from Puerto Rico is returned to the Puerto Rican Insular Government. If this arrangement were to continue and Puerto Rico's total molasses production were to be turned into rum, a total potential annual revenue of $90,000,000 is indicated, based upon the $18,000,000 collected on rum taxes by the Insular Government in 1941–42. Such revenues would go a long way toward stimulating employment, production, and living standards by allowing the Insular Government to finance large public housing and other public works programs. While this would imply a tremendous increase in sales of rum in the Continental United States, it should be remembered that the expansion of the last few years, due largely to the excellent marketing ability of the local producers, has indeed been phenomenal. About 10,000,000 or more additional gallons of molasses would become available for local processing if Puerto Rico refined its own raw sugar.

Although large quantities of molasses are shipped to the United States (or were before the tanker situation became so acute because of the war), it is obviously to Puerto Rico's advantage to convert it to higher-valued products by local processing before export. Molasses can be converted to industrial alcohol as well as to rum, but this is not so high in value, profit margins are smaller, and the large war-induced capacities for producing industrial alcohol from various types of raw materials in the United States do not warrant the belief that Puerto Rico can hope to compete in this market in the post-war period. Indeed, the conversion of industrial alcohol to a motor fuel is perfectly feasible if the right price relationship exists.

Other processes of fermentation of molasses can yield butyl alcohol, butanol-acetone, glycerine, acetic acid, citric acid, oxalic acid, and yeast. The Puerto Rico Reconstruction Administration developed the first, and at present the only, butyl alcohol plant in Puerto Rico—or indeed in the West Indies. This plant is rated to produce annually 3,000,000 pounds of butyl alcohol, 1,500,000 pounds of acetone, and 100,000 pounds of ethyl alcohol. It is now in full and efficient operation, a demonstration that a highly technical chemical process can be successfully carried on in Puerto Rico. The production of yeast for human consumption, made into a palatable form that can be added to existing food dishes, is extremely desirable as a means of supplementing the low protein and vitamin B complex diet of the population. Regardless of relative monetary returns, a substantial proportion of molasses production should be devoted to this purpose.

Dry ice is a byproduct of all molasses fermentation products. A small plant to manufacture dry ice has recently been started in conjunction with a rum distillery. There should be a large market for this product in the preservation of foods, especially fish, from the spoilage effects of tropical climate. Potash is also obtainable from the "slops" left over after the fermentation process.

Coconut products.—Present annual production of coconuts in Puerto Rico is estimated at about 22,000,000 nuts, but accurate production figures are difficult to obtain. This is partly due to the fact that an unknown number of new trees replacing those destroyed in the hurricane of 1932 are now coming into bearing. Heretofore coconuts have been exported to the United States under tariff protection in nut form for they were able to secure a better price as whole nuts than in any processed form and indeed a better price than would have justified their local processing. They offer, therefore, a clear example of a product whose use for local consumption, owing to the protection of the United States tariff, might well have to be protected through some form of governmental action, unless of course raw coconuts or copra from other areas are imported into Puerto Rico for local processing. It must also be noted that Puerto Rican production of nuts will be periodically reduced by hurricanes. Despite these limitations, however, certain local industries are possible of development in Puerto Rico and will presumably be given serious consideration during the war emergency to save shipping space.

1. Coconut fiber.—Imports of jute bags for packing raw sugar had a value of $1,250,000 in the fiscal year 1940–41. Ordinarily new bags are always used, with penalties on the use of old bags, but since Pearl Harbor the practice has been to have as many of the bags as possible returned for re-use. At present about 40 percent of the packing is in used bags. War conditions have given an opportunity to make new experiments, and a plant is about to be constructed in Mayaguez to make sugar bags from the fiber in coconut husks together with some imported sisal. This plant will be able to process even more than the total coconut fiber produced on the island. It should be noted, of course, that the production of bags for raw sugar and
the refining of the total sugar crop are mutually exclusive; i.e., if the latter industry is developed, the former will not be necessary since a different type of bag is required for refined sugar.

2. Coconut oil and meat.—A refining plant has been recently installed in Puerto Rico whose annual capacity to produce copra and refine the oil is said to be about 13,200,000 nuts. This capacity, with minor extra equipment, could be expanded to handle 19,800,000 nuts annually. From this potential capacity, 422,400 gallons of crude oil could be produced with employment of about 150 men. The crude oil can be used for soap making. Refined, it can be used in manufacturing edible oil and oleomargarine, for a sufficient market exists in the Island for this full production.

3. Shredded coconut.—Some shredded coconut is manufactured on the Island for export. The local shredding plant, if it were operating at full capacity, could consume 5,500,000 nuts annually.

Sea Island cotton.—Local cotton is of the Sea Island variety and of very fine quality. The material would have to be exported since a sufficient market does not exist in Puerto Rico, although the spinning and weaving of this cotton for high-grade export fabrics has been suggested. The cotton seed is being used at present as a feed for cattle, but it would be desirable if the oil could be separated and utilized for human consumption, thereby also improving the feed itself. Facilities exist for such processing.

Essential oils and perfumes.—Definite but limited possibilities exist for the development of essential oils from local products such as coffee, bitter orange, citronella, lemon grass, vetiver and ylang-ylang, but, as already stated, the total demand for these products is so small that no substantial part of the Island’s economy could be supported by them. For instance if 15,000 acres, approximately 10 percent of the Puerto Rican coffee lands, were devoted to vanilla cultivation, they could supply the entire demand of the United States.

Tobacco.—Tobacco grown in Puerto Rico is also semi-processed on the island. The tobacco-stripping industry is well established and any future expansion must depend on increasing demand on the continent for Puerto Rican tobacco for cigar filler. The production of hand-made cigars, formerly a large source of employment, has declined greatly, and the mass mechanization of cigar production in the United States precludes the growth of a local industry for export.

Industries Based on Forest Resources

Since the forest resources of Puerto Rico have been largely depleted and since extensive reforestation is not feasible because of the pressure for agricultural land, industries based on forest resources are limited. There are, however, a few economic possibilities for establishing small industries or expanding existing ones, based on present forest resources and imported raw materials.

Charcoal.—Charcoal production is the largest single forest-based industry in Puerto Rico; charcoal is used for fuel throughout the Island. Estimates of annual consumption vary from 10 million to 15 million 40-pound bags at 1 cent a pound. This consumption makes charcoal production a 4-million-dollar-a-year industry locally, for only 25,000 bags a year are regularly imported from the Dominican Republic, Cuba, and the British West Indies. Few data regarding the economy of this relatively large industry are available. According to a recent study, one stand of pure pomerrosa on poor soil near Cidra yielded 240 sacks of charcoal per acre, 6 years after planting, returning $65 to the farmer or about $10 a year per acre.

Perhaps one explanation of why such cost data are not available is that about half the Island’s charcoal has been a byproduct of shade-tree thinnings in the coffee area. In general, charcoal production in Puerto Rico will probably remain a subsidiary farming operation, as it is in the coffee area, or a byproduct of forestry operations, as discussed in the section on forest resources. Improved management practices might greatly increase yield, but it is doubtful that any reasonably sized area could support a family. As a part of farm production, on the other hand, charcoal produced from forests on the steeper and poorer soils can, while protecting and improving these sites, provide needed supplementary income. By using modern methods of production, not only a better grade of charcoal could be obtained but also valuable byproducts such as wood creosote, tar, and pyroligenous liquor. The tar and creosote have fuel value, but might better be used for wood painting and impregnation to guard against termite attack. Pyroligenous liquors can be processed to recover acetic acid, acetone, methanol, etc. Modern methods of charcoal production consist of placing the wood in a horizontal cast-iron retort fired from the outside with fuel oil as well as with noncondensible gases evolved from the wood. A complete still capable of making 50 bags of charcoal a day has been put into operation in Puerto Rico, at a cost of less than $2,000, but its economy has yet to be fully demonstrated.

Bamboo products.—Processing of bamboo has economic possibilities. This wood is quick growing and has a hard, resistant surface and a distinctive tropical appearance. Unfortunately, however, its development has been held back because of its susceptibility to beetle infestation and the difficulties of designing high-utility products from it. During the last several years
the first handicap has been at least partially overcome by the work of the Federal Agricultural Experiment Station at Mayaguez, which has developed a prolifically growing beetle-resistant bamboo (Bambusa tulda). About 200,000 lineal feet of this bamboo ranging from 1 to 4 inches in diameter could be produced annually from present plantings of 17 acres. The second handicap has been turned into an asset by the work of the station in developing attractive designs which utilize the simple lines of the bamboo as a basic element in furniture models. As a result of this work, new bamboo furniture is now being made by private companies and sold as fast as it can be turned out.

_Tannin._—There are some 16,000 acres of mangrove trees in Puerto Rico, which are used principally for charcoal, but whose bark contains tannins of the catechol group that can form the basis for a new industry. The species _Rhizophora_ or red mangrove, most commonly used as a source of tannins, constitutes about 20 percent of the mangrove forests and contains from 30 to 38 percent of tannin.

The recent inauguration of a tannin industry originated when, as a means of obtaining preservatives for fish lines and nets, the United States Fish and Wildlife Service at Mayaguez developed an economical method of extracting tannin from mangrove bark which can compete with imported tannin. This extract has been successfully used in the treatment of skins at tanneries located near Mayaguez and at Cataño. It has been reported that the skins treated and compared favorably with skins formerly treated with quebracho extract imported from South America before the war cut off this supply. As a result of this successful experiment the Insular Forest Service made available 1,500 acres of mangrove forest at Boquerón and La Parguera. Fifty men were put to work cutting trees and stripping 3,000 pounds of bark per day, while the extraction plant employed three men. Since 3,000 pounds of bark will produce 1,500 gallons of tannin extract or enough to treat 3,000 pounds of green hides, the equivalent of 1,700 pounds of leather, and since Puerto Rico's total present requirements for locally tanned leather average 5,000 pounds per day, 147 men could be permanently employed on tree-cutting and bark-stripping operations alone. Present requirements of the fishing industry are 6,000 pounds of bark annually to preserve fishing lines and nets. Future requirements may reach as high as 30,000 pounds a year.

_Crates._—Many smaller trees, now used either for charcoal production or not at all, could be employed in the manufacture of crates for fresh tomatoes, pineapples, and cucumbers that in peacetime are exported to the United States in boxes made from imported lumber. The species _Almásigo_ is particularly good for this purpose.

_Furniture._—There is at present a fairly well established, though small, furniture industry in Puerto Rico, using mostly imported hardwoods and depending largely on the local market. According to the 1939 Census of Manufactures, it employed 687 workers and ranked fifth among all manufactures in Puerto Rico in number employed. However, the value added by manufacture was only $364,866, placing it eleventh among the industries reported. It is believed that the industry could be considerably expanded, even if only for the local market, since imports of wood furniture in 1941 were valued at approximately $1,050,000. Another basis for expansion is that all furniture in the tropics should be made of termite-resistant woods, which are usually tropical woods and can be imported easily from neighboring islands. Any considerable expansion, however, whether for the local or export market, must be based on a rationalization of the industry and improved, distinctive design. For these are necessary if the advantages of large-scale buying and selling are to be secured.

_Industries Based on Minerals_

_Glass._—Silica sand deposits of high quality and adequate quantity to supply raw material for a modern glass-container-and-bottle plant exist on the north coast of the Island. Approximately 28,000,000 glass containers are imported into Puerto Rico annually for the export rum trade alone. The Puerto Rico Development Co. has already organized a subsidiary company, purchased a plant site, secured priorities, and begun construction of a glass-container-manufacturing plant. Glass containers of all kinds and pressed glassware will be produced at the rate of 100 tons per day, giving direct factory employment to about 117 men. While this new plant will be of sufficient size to supply the existing market, a 50-percent increase in production (35 percent in employment) could be managed without major new construction if further expansion of the rum industry warranted it. A small hand-made specialty and artistic glass works, producing first for the local and tourist trade and later for export to the States, could be established experimentally as a subsidiary of the glass-container plant. Glass bricks for building purposes can also be manufactured from this sand.

_Ceramics._—There are apparently good possibilities of setting up several small semi-mechanized potteries for local consumption based on the use of various types of clay and having a market for their products in the Territory. Any clay deposits which have been found so far have not been sufficiently examined to determine their suitability for making pottery. However, most of the clay which has been used in the Territory has been imported from Germany and Mexico, and it is possible that the local clays could be used for making pottery. The few mahogany trees in Puerto Rico are exotic, not indigenous, and have been planted usually for shade or ornament. Like other hardwood trees which are or may be grown in Puerto Rico, they could be used only to supplement a more reliable imported supply.
of clay bodies from well-suited local clays. Initially a utility-pottery industry could be started to produce liquor jugs, coffee pots, and ordinary tableware; later it could be expanded into the production of cheap whiteware pottery for which local deposits of kaolin are believed to be suitable. Certain clay deposits are suitable for the production of pottery cooking ware, and other local clays can be used to make refractory and oven brick for which an adequate market would be available, especially in the sugar industry. Pottery could be made into vases, ash trays, lamp bases, and decorative tableware for the local and tourist trade and eventually, after the development of a characteristic line of design, for the export market. In the post-war period when construction is again possible, there should be a large market for sand and lime brick, floor tiles, roof tiles, and drum tiles.

Marble.—The excellent grade of marble available on the Island can be used for ornamental building purposes. However, it is extremely doubtful that any sizable sustained industry can be built up.

Cement.—Two plants, one on the north coast and one on the south coast, have been completed in the last few years. Their capacity is believed to be sufficient to supply all potential local needs in the post-war period.

Ferromanganese.—While deposits of both iron and manganese exist on the island, their development and operation would probably be marginal. The feasibility of developing these deposits commercially must depend upon further detailed investigation and experimentation as to the quantity and uniform quality of the deposits and as to comparative production costs.

Industries Based on Imported Materials

Cotton textiles.—Locally produced Sea Island cotton is of too high a quality and price to be used in Puerto Rico for the manufacture of textiles for local use. However, cotton mills using imported cotton have been successfully established in a number of South American countries. It is believed that a similar mill could be set up in Puerto Rico to produce a large part of the cotton textile yard goods, especially the coarser grades, and coarse knitting yarns and twines for sewing sugar bags. Cotton stockings, socks, thread, twine, sheeting, underwear, and work clothes seem the most logical items with which to start production. The manufacture of cotton osnaburg for sugar bags, which has been suggested, does not appear desirable if the coconut-fiber bagging previously discussed is successful, since the latter product would use local rather than imported materials. The outlook would be changed in favor of cotton bags if Puerto Rico could ship refined instead of raw sugar. Based on 20,000 spindles, the industry would employ directly about 1,000 workers. It is understood that Cuba has an industry of 33,000 spindles and is installing 50,000 more.

Needlework.—The needlework industry is well established on the Island, especially in the Mayaguez section, where both needed managerial and labor skills exist in abundance. But the industry was hard hit by the application of the Federal Fair Labor Standards Act in 1938, which changed the wage rate from as low as 2½ cents an hour to the minimum of 35 cents, though later a special agreement permitted a wage of 12½ cents. Needlework products exported in 1936–37 were worth $20,700,000, as compared with $12,100,000 in 1941–42. Since this work is mostly done in the home, it offers supplementary income to rural families, especially in the distressed coffee region around Mayaguez, and its expansion should be encouraged by all possible means, as long as the former labor exploitation can be prevented. Unfortunately, however, the market for needlework in the States is a price market and cannot be greatly expanded except by the cutting of costs, principally labor, in order to compete with machine-made articles. Fine needlework is desired by all classes of buyers, but the mass of consumers will only purchase hand instead of machine needlework at a bargain price. Therefore, a large market and large employment can only be secured at low wages. On the other hand adequate wages can be secured only with a low employment for a definitely restricted luxury market.

Other products.—A number of other industries using imported raw materials have already been successfully established in Puerto Rico, although some difficulty is being encountered now in securing these materials because of the war. As already noted, such industries usually are ones requiring painstaking and delicate hand skills, such as diamond cutting, jewel bearings, hat weaving, and the making of pearl buttons, petit point, and fine rugs. Several others requiring similar skills have been suggested for development, such as silk hosiery weaving, radio-part assembly, fine leather tooling, watch assembly, and the manufacture of toys and Christmas-tree ornaments.

Commerce

Because commerce is so dependent on basic production, and because its expansion is closely determined by the expansion of total income, it is not considered separately in this plan. It might be pointed out, however, that retail trade and services have never been closely integrated in Puerto Rico; they are still almost exclusively dominated by relatively small independent enter-

Both figures include the value of imported materials, whose amount may be as much as 60 percent of the total.
prizes. This is particularly true in the fresh fruit and vegetable trade, in which the establishment of farmers' markets would constitute one desirable improvement.

**Fisheries**

**Salt-Water Fisheries**

In Puerto Rico local fishery resources have not been extensively developed, although the importance of fish as an essential food element in over-populated tropical areas is well recognized. Factors which have inhibited such development include the lack of refrigeration and marketing facilities, the inability of local fishermen to afford gear and equipment that would make operations commercially successful, and public fear of poisoning from fish, which has occurred sporadically, and perhaps also by the allegation that fish are not abundant in Puerto Rican waters. Since 1940, with the increasing difficulty of importing food and the rising prices of codfish from the Newfoundland Banks, more attention has been given to the study and development of local fishery resources. But the fact must be faced that war conditions such as blackouts, submarine dangers, harbor entrance schedules, lack of weather reports, and particularly difficulties in obtaining equipment will prevent any great expansion in this field for the duration, even if rich fishing grounds can be shown to exist. Present circumstances should not, however, limit needed research in the development of a real fishing industry both in Puerto Rico and throughout the Caribbean generally, so that, when conditions permit, the industry may be able to expand rapidly and on a sound basis.

The Puerto Rico Department of Agriculture and Commerce, through its Division of Ornithology and Pisciculture, in cooperation with the United States Fish and Wildlife Service, has started such a fishery research program. A physical and biological exploration of the waters adjacent to Puerto Rico is being conducted with a modern fishing vessel equipped with varied gear to obtain information relative to the species of food fish available, time of abundance, location of new fishing grounds, and the best types of boats and fishing gear adaptable to local conditions. Studies of a technological character are also being carried out to determine improved methods of handling fresh fish; freezing, salting, and drying of fish; the utilization of fishery by-products; and the causes of food poisoning from fish. A marketing survey by the Puerto Rico Agricultural Experiment Station, the Department of Agriculture and Commerce, and the Fish and Wildlife Service was initiated in August 1942. The completion of these surveys should establish a fund of basic data as to resources and techniques and indicate the extent to which a sound fishing industry can be developed in Puerto Rico. There is a shortage of personnel, however, and more technicians trained in chemistry, engineering, and economics are needed for work in this field.

A 6-month joint fisheries survey of wide scope which covered the entire Caribbean area has recently been completed by the Office of Inter-American Affairs, the United States State Department, and the United States Department of the Interior. The results of this study are now being compiled in Washington. The British Government is planning a similar survey near Barbados, with an exploratory vessel based at Trinidad, and an exploratory survey of the fisheries of the Amazon is contemplated. When these surveys are completed, it is possible that an International Fisheries Commission may be formed for the Caribbean area, and that international and inter-island agreements may be reached on the use of fishing banks in the Caribbean area in order to prevent possible overexploitation.

Several concrete steps have recently been taken to expand the fishing industry of Puerto Rico in addition to this survey work. They should of course be expanded if and when conditions permit. With the help of the Farm Security Administration, cooperative arrangements among fishermen are being developed to improve the handling, transportation, refrigeration, and marketing of fish. A combination agricultural and fisheries cooperative has already been organized at Pozuelo, and the Farm Security Administration contemplates establishment of additional cooperatives at other fishing ports. These groups are made up of small-scale farmers whose inadequate incomes from farming need to be supplemented, although agriculture must continue to be a substantial part of each member's total enterprise. The Insular Department of Agriculture and Commerce is also using local emergency funds to try to obtain necessary equipment for loan or sale to fishermen and to install physical facilities for preservation and marketing. In this latter connection, specific plans might well be developed for port facilities, including refrigeration, at all present or potential fishing points—Las Cabezas (near Fajardo), Puerto Real, Cataño, Guánica, Aguadilla, Mayaguez, Arroyo, Salinas, Parguera, and Isabel Segunda in Vieques—so that necessary construction under public or private auspices may start as soon as conditions permit. Finally, a comprehensive sanitary code for fish marketing should be prepared by the Insular Department of Agriculture and Commerce or other appropriate agency.

In 1940 over 30 million pounds of dry salted fish, costing the people of Puerto Rico $1.5 million, were imported. This is the equivalent of between 120 million and 150 million pounds of fresh fish and constitutes...
the ultimate production goal for Puerto Rico. Present production is about 5 million pounds. In order even to maintain the latter level, about $50,000 worth of equipment for replacements of worn-out gear and miscellaneous items is needed, because of war-induced shortages of repair materials. The fisheries industry employs about 1,500 people in the Island. If the ultimate production goals set forth above could be achieved, it is estimated that fisheries employment could be increased to 15,000 people. This is based on the assumption that present production could be tripled through the use of existing facilities and personnel but with more intensive operations. With present poor marketing facilities and uncertainty of selling fish, there is little incentive for hard work, even though the average wholesale price for whole fresh fish to the fishermen has increased from a pre-war figure of 6 cents per pound to 10 cents per pound.

Fresh-Water Fisheries and Wildlife

Fresh-water farm fishponds have long been used in the Far East to supply high-protein food for the people of these densely populated areas. In Puerto Rico, abundant rainfall provides for annual streams and a few small lakes and artificial reservoirs in which freshwater fish could be similarly propagated to supplement the food supply. During the past 4 years over 250,000 fish, (bluegill, sunfish, rainbow trout, bullhead, and channel catfish), artificially reared at the Maricao fish hatchery, have been planted in the inland waters. From a technical standpoint, fresh-water fisheries offer dependable sources of supply, so that every effort should be made through appropriate Government agencies to encourage the production of these fish. Although a fishpond one acre in area will in Puerto Rico yield between 200 and 400 pounds of fish, which with present market prices would bring an average income of $30 per acre, it is not believed that modern methods of increasing fishpond production with the use of fertilizers can be practiced extensively in Puerto Rico, for most fertilizers or their component materials have to be imported. The possible use of seaweed for this purpose should be investigated.

In addition to their use for fish propagation, certain ponds and lagoons in Puerto Rico are used as refuges for migratory and native waterfowl. Minimum water levels should be maintained for use of waterfowl in certain lagoons, particularly on the southwest coast, such as those of Cartagena, Anegado, and Guánica, which are at present pumped dry every year for irrigation of adjacent sugar lands. In general, however, Puerto Rico can never expect to preserve any large areas for very extensive use as wildlife refuges.

Water Power and Other Energy Resources

There are no economically exploitable coal or oil shale deposits in Puerto Rico, and techniques for utilizing energy from the sun and thermal differences in water masses have not developed to a point of practical application under local conditions. Yet for several reasons it is desirable that the Island depend as little as possible on outside sources for its power needs. The cost of using imported fuel oil for steam-generated power and of falling water for hydroelectric power cannot be directly compared, since so much Federal money has gone into the latter, which is not reflected in local costs; but in general hydroelectric power is more economical, particularly so when developed as a part of larger multiple-purpose projects. Reliance upon imported fuel oil, even if it should cost no more as an energy source, requires that Puerto Rico export badly needed goods and services in exchange for the oil. Furthermore, the supply of fuel oil may be easily cut off during emergencies. For all of these reasons, Puerto Rico early recognized the desirability of developing its hydroelectric resources. The first public hydroelectric plant was built in 1915, and the first private plant in 1900. Figure 9 shows the present electric energy generating facilities and the electrical distribution network in the island.

Table 19 shows production of public utility electric power in kilowatt hours by type during the last 7 years.

<table>
<thead>
<tr>
<th>Fiscal year</th>
<th>Water power</th>
<th>Steam power</th>
<th>Steam power bought from sugar mills</th>
<th>Total kilowatt-hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1935-36</td>
<td>84,010,700</td>
<td>27,330,460</td>
<td>2,127,540</td>
<td>109,474,600</td>
</tr>
<tr>
<td>1936-37</td>
<td>86,719,360</td>
<td>28,830,870</td>
<td>1,238,575</td>
<td>119,088,700</td>
</tr>
<tr>
<td>1937-38</td>
<td>85,250,040</td>
<td>31,248,800</td>
<td>1,238,575</td>
<td>126,469,415</td>
</tr>
<tr>
<td>1938-39</td>
<td>79,787,670</td>
<td>49,045,015</td>
<td>1,126,745</td>
<td>165,658,430</td>
</tr>
<tr>
<td>1939-40</td>
<td>70,000,840</td>
<td>75,014,410</td>
<td>3,360,775</td>
<td>145,376,025</td>
</tr>
<tr>
<td>1940-41</td>
<td>101,743,660</td>
<td>82,977,940</td>
<td>4,094,430</td>
<td>193,617,030</td>
</tr>
<tr>
<td>1941-42</td>
<td>120,265,650</td>
<td>106,555,470</td>
<td>4,094,430</td>
<td>231,115,850</td>
</tr>
</tbody>
</table>

Steam power has increased in importance as a source of energy from 29 percent of the total kilowatt-hours consumed in 1935-36 to 46 percent in 1941-42 and water power has decreased from 68 percent to 52 percent, because the demand for electric energy has increased more rapidly than water-power generating capacity could be increased, throwing the surplus burden onto steam.

Hydroelectric power resources, however, can be tripled in Puerto Rico; for, of 68,000 potential hydroelectric firm horsepower, only 20,500 have been developed. The data indicate that such expansion should be planned, since recently there has been a steady growth in the
electric load for the Island as a whole, increasing at an average rate of nearly 20 million kilowatt-hours each year, and it is most probable that the electric load will increase at a more rapid rate over the next few years in view of the prospective demands from industrial developments contemplated by the Puerto Rico Development Co. However, where potential hydroelectric power developments may permanently divert water from irrigable lands, the relative benefits of electric power and agriculture should be considered in advance of project developments. This may become an important question of policy in the Isabela irrigation district where, owing to a temporary decrease in demand for irrigation water, there is the temptation to divert it permanently for power development.

In order to plan for power development in Puerto Rico the following steps should be taken.

1. Surveys and investigations should be made to determine feasibility of:
   (a) Installing wind turbine electric generators, followed by careful selection of prospective sites.
   (b) Deriving more electric energy from bagasse by replacing low-pressure generating units with more efficient high-pressure boilers and steam turbines at the centrals. If the centrals were also equipped with furnaces arranged to burn both bagasse and fuel oil and with bleeding turbines which could be operated with condensing units during the nongrinding season, the centrals could serve as stand-by plants, thus avoiding duplication of investment in separate stand-by plants.26

2. A priority schedule should be developed for construction of feasible power projects included in the tentative long-range construction program of the Puerto Rico Water Resources Authority indicated in table 20.

3. The following projects should be completed:
   (a) Dos Bocas hydroelectric plant. Generating capacity ultimately to be installed: 22,500 kilovolt-amperes.27
   (b) New installations of the Mayaguez steam-electric plant now under way. Present plant generating capacity will be increased by 6,250 kilovolt-amperes.

4. The following projects should be constructed:
   (a) Upper Rio Blanco hydroelectric plant to develop 12 million kilowatt-hours of electricity annually and to increase the generating capacity of the existing lower Rio Blanco plant by 6 million kilowatt-hours annually.
   (b) Three new hydroelectric plants in the Isabela irrigation district to develop 2,500 kilovolt-

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26 Refer to Industry and Commerce Section.
27 7,500 kilovolt-amperes are now in operation.

### Table 20.—Tentative long-range construction program of the Puerto Rico Water Resources Authority (April 1943)

<table>
<thead>
<tr>
<th>Name of project</th>
<th>Location</th>
<th>Nature of project</th>
<th>Estimated cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Añasco</td>
<td>Añasco River near Las Marías.</td>
<td>Hydroelectric development</td>
<td>$11,000,000</td>
</tr>
<tr>
<td>Cañillas, Utuado</td>
<td>Cañillas River, Utuado.</td>
<td>Hydroelectric development</td>
<td>4,000,000</td>
</tr>
<tr>
<td>Saliente diversion</td>
<td>Saliente River, Jayuya.</td>
<td>Hydroelectric development</td>
<td>2,000,000</td>
</tr>
<tr>
<td>El Verde</td>
<td>Espiritu Santo River, Caribbean National Forest.</td>
<td>Hydroelectric development</td>
<td>2,450,000</td>
</tr>
<tr>
<td>Tres Saltos</td>
<td>Espiritu Santo River, Caribbean National Forest.</td>
<td>Hydroelectric development</td>
<td>2,450,000</td>
</tr>
<tr>
<td>Baño de Oso</td>
<td>Canovanas River, Caribbean National Forest.</td>
<td>Hydroelectric development</td>
<td>2,450,000</td>
</tr>
<tr>
<td>Guayabal</td>
<td>Canovanas River, Caribbean National Forest.</td>
<td>Hydroelectric development</td>
<td>2,450,000</td>
</tr>
<tr>
<td>Baño diversion</td>
<td>Guayabal Dam</td>
<td>Hydroelectric development</td>
<td>2,450,000</td>
</tr>
<tr>
<td>Bauta diversion</td>
<td>Bauta River, Barrio Damíán, Groovis.</td>
<td>Hydroelectric development</td>
<td>2,450,000</td>
</tr>
<tr>
<td>Santurce steam plant</td>
<td>Santurce</td>
<td>Storage dam for power and water supply</td>
<td>3,300,000</td>
</tr>
<tr>
<td>Ponce steam plant</td>
<td>Ponce.</td>
<td>Hydroelectric development</td>
<td>1,070,000</td>
</tr>
<tr>
<td>Maguana steam plant</td>
<td>Maguana.</td>
<td>Hydroelectric development</td>
<td>1,250,000</td>
</tr>
<tr>
<td>San Juan underground system</td>
<td>San Juan.</td>
<td>Raising of dam about 25 feet and construction of power plant.</td>
<td>1,400,000</td>
</tr>
<tr>
<td>Electrical transmission system</td>
<td>Throughout the island.</td>
<td>Extension of Bauta River into Matrullas Reservoir, Toro Negro hydroelectric project.</td>
<td>300,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installation of additional generating equipment.</td>
<td>750,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installation of additional generating equipment.</td>
<td>500,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installation of underground primary system and improvements.</td>
<td>500,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extension and improvements of electrical transmission lines.</td>
<td>2,000,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total.</td>
<td>$31,920,000</td>
</tr>
</tbody>
</table>
amperes utilizing existing water-control developments of Guajataca Reservoir and canals, provided irrigation water needed for agricultural areas can be reserved.

(c) Hydroelectric features of the proposed Lajas and Manatí-Vega Baja irrigation projects to develop 2,000 kilovolt-amperes of electric energy. (See section on water resources for agriculture.)

Transportation and Shipping

Puerto Rico has a fairly good system of highways. (See fig. 10). As a matter of fact the principal problem is whether local resources are sufficient to maintain adequately the present mileage as well as other Government services such as schools and hospitals. Cost of highway maintenance in 1940–41 was $1,221,000, or an average of $478 for each kilometer maintained. On the other hand, the standards of the primary roads in Puerto Rico could be greatly improved. Only with the initiation of Federal aid beginning July 1, 1937, was more modern road construction in terms of United States standards begun. The San Juan-Punta Borinquen Highway was the first project of any appreciable extent undertaken with Federal aid, and the completed units are the most modern on the Island.

In Puerto Rico, an island 100 miles long by 35 miles wide, there are 1,830 miles of insular and municipal hard-surfaced roads, of which 1,180 miles are in the Federal-aid system. In addition there is an undetermined mileage of trails or unimproved rights-of-way. Total motor vehicle registration in Puerto Rico increased from 17,028 for the fiscal year 1935 to 31,806 for 1942, but war conditions have recently initiated a
downward trend so that only 25,933 vehicles were registered as of March 1943. Of the 1942 registration, 22,959 were passenger vehicles and 8,847 were trucks.

Certainly during the war the Island's road system should be maintained; for, although civilian travel by motor vehicles has been greatly curtailed because of war needs, good highways are required not only for the use of military vehicles but also to maintain the efficiency of the limited but essential civilian highway transportation services. Roads must also be kept in good condition to prolong the life of trucks and other civilian vehicles. With the importation of foodstuffs restricted by war conditions, Puerto Rico must become more nearly self-sufficient in agricultural food products. For this program, farm-to-market roads need to be maintained to assure quick truck delivery of perishable food products.

Before any major new roads are built or before any present roads are reconstructed, except those recommended below or others immediately required for definite military needs, a transportation survey should be conducted as a phase of the land-use survey recommended in the section on agriculture, to determine road requirements in relation to distribution of population and agricultural, industrial, and other resources, for Puerto Rico does not even have the less extensive highway planning survey which has been conducted in most of the States. It is understood that the Puerto Rico Planning Board is already making spot studies for new farm-to-market roads and is inventorying the Island's road system. The results of these inquiries should form the basis for any new farm-to-market roads or major road improvements. Early completion of the topographic maps of Puerto Rico from already completed aerial photographs would be an important adjunct to a highway planning survey. The adoption of the United States Coast and Geodetic Surveys system of plane coordinate control for all surveys and mapping is recommended as the standard method to be followed.

The Census of Agriculture for 1940 reported 7,612 farms as located on paved roads and 1,844 located on other than paved roads. It further reported 4,050 farms as being located 0.5 kilometer or less from a road, 5,999 farms as being located between 0.5 and 1 kilometer from a road, and 36,000 farms as being located further than 1 kilometer from a road. The relative size and value of these farms is not known. A highway planning survey would reveal this information. On the other hand, it is known that only 1,176 farms were reported as having automobiles and 667 farms were reported as having motor trucks, the number respectively being 1,568 and 1,106. The average automobile and truck were models of 1936 and 1937. It is probably a safe assumption that the larger, more prosperous farms own most of these vehicles, and they are located on the coastal plains served by fairly good roads. The smaller farms are scattered throughout the mountainous interior and the economic feasibility of constructing additional roads for motor vehicles to serve them may be questionable. Hence an expansion of the present ox-cart trail systems might be adequate except where roads are needed in areas that could be developed as food production centers.

Meanwhile, since present road mileage is sufficient to handle curtailed traffic, there are several reasons why it might be better to postpone most road construction until after the war. Few motor vehicles are being manufactured except for military use; unless a suitable rubber substitute is found, what unessential cars there are will soon be off the road; and the trends of post-war motor vehicle construction are unknown. There may be radically new motor vehicle planning with consequent adoption of new concepts in highway design and construction. For example, it is not known whether motor vehicles will in general be light and flexible or whether the pre-war trend toward heavier, more luxurious vehicles, even for the low-income groups, will continue. Finally there will be a lag between the end of the war and the time the automobile industry can again swing into mass production of new automobiles.

With Insular funds for construction reduced during the emergency and especially with present difficulties of obtaining construction equipment and materials, rights-of-way for post-war construction of improvements to the highway system, rather than actual construction of new roads, should be planned and completed.

Obviously needed major improvements for the post-war period include reconstruction, in part, of existing roads to provide two high-standard transmountain highways—one between San Juan and Ponce via either Salinas or Coamo, and one between Arecibo and Ponce—as well as a high-standard circumferential coastal highway. These highways serve the eight most important population centers: San Juan, Ponce, Mayagüez, Caguas, Arecibo, Río Piedras, Bayamón, and Aguadilla. Major improvements in the existing coastal highway are needed only on specific limited sections, while minor improvements on the remainder would suffice to bring them up to desirable standards.

Experience in modern road construction to date on the San Juan-Punta Borrinquen highway has shown

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38 Special problems involved in the coastal highways are: (a) the feasibility of constructing a new highway unit extending south from the junction of routes 2 and 8 near Moca to the junction of routes 2 and 40 near Añasco, (b) a bypass around Aguadilla, and (c) the reconstruction to modern standards of the coastal highway between Guayanilla and Humacao to assure adequate transportation facilities over this gap in the railroad system. (See section on railroads.)
Development Plan for Puerto Rico

that construction costs have averaged $62,207 per mile for a length of 5 miles constructed under contract.

It is recommended that broader rights-of-way be acquired or highways be zoned to protect the public investment and to prevent construction of new developments encroaching on rights-of-way such as commercial roadside stands and advertising markers. It is also recommended that traffic direction signs for all highways and signs for all city streets be provided after the war.

**Railways**

Although existing railways are all of narrow gauge, they supplement in a very important degree the high-service railroads and 41 miles of private-service lines; "t products, chiefly sugar, as compared with about 5 percent for the United States. Because of its long distance from world markets, including the United States and South America, and its isolated position geographically, low-cost transportation is therefore more essential for Puerto Rico than for Continental United States. Puerto Rico's residents pay transportation charges on practically all imported commodities, while at the same time many of the Island's producers have to absorb transportation charges on shipments of materials to Continental United States markets because they must sell their products in competition with producers nearer those markets.

Even if cargo planes become important carriers of perishable food products, mail, and other high-tariff freight after the war, ocean shipping will remain the important carrier of bulk and heavy cargoes such as sugar, canned products and other imperishable goods. (Ninety percent of Puerto Rico's export volume is sugar, a bulk product.) Hence, the Puerto Rico Transportation Act authorizes the Insular Government, "to develop and improve, own, operate, and manage any and all types of transportation facilities in, to, and from the Island of Puerto Rico and to make available the benefits thereof in the widest economic manner, thereby promoting the general welfare and increasing commerce and prosperity." Under this act a publicly owned shipping corporation could be legally established, but, unless the United States steamship lines now serving the island are inefficient or are making great profits, Puerto Rican ownership itself would not be able to reduce costs. This assumes that Puerto Rico would pay the same wages and the same prices for oil and other operating materials. It has been argued, however, that such a company, even if it could not operate more economically than the present lines now serving Puerto Rico, might be able to adopt certain policies of operation which would be specifically designed to assist Puerto Rico's economy: (1) fix cheap or even subsidy rates to promote new industries in the Island; (2) expand the Caribbean region's trade with Latin American countries; (3) keep in the Island whatever profits might be earned; and (4) establish more convenient and flexible schedules. During the present emergency such a company could secure only small freighters and schooners, but after the war it might be able to obtain at nominal cost larger ships from the War Shipping Administration.

It has also been suggested that Puerto Rico could expand its trade by establishing San Juan as a free port—although it is doubtful whether there will ever be enough transshipment and other free port trade activities to justify free port facilities both at San Juan and at Charlotte Amalie in the Virgin Islands, which has

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8 Although it appears desirable, it would probably be economically infeasible to close the gap in the Island's circumferential railroad system, because of the difficult mountainous terrain between Guayama and Humacao. It is therefore suggested that improvements in the circumferential coastal highway between these towns be given a high priority. (See section on Highways.)
long been such a port. In any event post-war projects should include the maintenance of harbors and the construction of necessary navigation improvements at San Juan, Arecibo, Agüadilla, Mayagüez, Guayama, Ponce, and Fajardo.

Air Transportation

Until discontinued under wartime restrictions, intra-island air transportation had developed fairly satisfactorily. International air transportation, on the other hand, has greatly expanded because of wartime demands. The Public Counsel of the Civil Aeronautics Board recently has recommended that another air-line company be permitted to operate between Continental United States and San Juan; for San Juan is a key point in all air transportation between the east coasts of North and South America. Both land and sea plane facilities, of a character adequate to handle all probable internal air needs are available, but there is no nonmilitary airfield in Puerto Rico equipped to handle large international planes; the field at present being used for this traffic is owned and operated by the United States Navy. Probably this and other fields will be available for more convenient civilian air use after the war; but, if not, the construction of a first-class civilian airfield should definitely be at the top of any post-war list of public works. For without such facilities San Juan will not be able to play the part called for by its geographical location in peacetime air transportation between the two continents. In general, “airport zoning” or its equivalent, terminal facilities, and transportation connections to all airports should be planned in advance of peacetime expansion.

If cargo transportation by air develops after the war as it has during the war, it may indirectly stimulate the development of specialty crops, although Puerto Rico will still be in as relatively weak a position as it is now in the face of Florida and Cuban competition. A more important indirect effect of post-war air expansion should be an increase in the tourist traffic and a greater interchange of culture, ideas, and personnel between the mainland and the Island.

Communications

On any island external communication facilities are always important. Fortunately, such facilities between Puerto Rico and the United States are adequate although the quality of present radiotelephone connections might be improved. Existing inter-island communications, on the other hand, would be inadequate if any substantial increase in Caribbean interdependence were to take place and might require the provision of a short-wave radio station. Finally, intr岛an communications are also important and fortunately they likewise are adequate. An island-wide telephone system is supplemented by a very extensive publicly owned telegraph system and several radio stations. Both the radio stations and the island-wide press should be even more extensively used in fulfilling the various educational functions which this plan indicates are basic for the future development of the Island.

Tourism

The expansion of the tourist industry of Puerto Rico has long been advocated as a means of increasing the Island’s income and employment. For Puerto Rico does possess that great asset of all the West Indian Islands—a fine, equable year-round climate—and other West Indian Islands have profitably encouraged such development, particularly Cuba, Jamaica, and Barbados. Toward this end an Institute of Tourism was created in 1937 by the Puerto Rico Legislature, and a rather large-scale program to attract tourists to the Island was launched. During the fiscal year 1940, however, Puerto Rico was visited by only some 16,000 regular excursionists (about the number visiting the much smaller island of St. Thomas) and in 1941 by 19,000. It is perhaps doubtful whether Puerto Rico will ever be able to appeal sufficiently to tourists to develop a relatively large industry comparable, for instance, to that of Barbados or St. Thomas. Aside from Cuba and Nassau, which are close to the United States, it is believed that most continental tourists will, if they can come as far as Puerto Rico, continue to vacation in places where English is more generally spoken, or else in places which are more completely different in culture than Puerto Rico.

Some expansion in tourism might well prove practical, but recreational facilities for residents should not be neglected in order to make this expansion possible. Indeed, local recreational facilities might form the basis for tourist expansion itself. But this expansion must be based on the maintenance of very high standards of cleanliness and general sanitation, so that whatever expansion is decided upon should be built up more or less in one center as in Cuba or Jamaica. For unhealthful conditions prevalent in most West Indian Islands, such as malaria, dysentery, impure water, and sanitary facilities far below continental standards do not make it feasible at present to disperse recreational areas throughout Puerto Rico, except for overnight accommodations for motor tourists at key scenic points.

It is generally agreed that the most logical location for the development of such a main tourist area should be a beach and mountain reservation covering about 20 square miles in the Luquillo-El Yunque area. Within
Development Plan for Puerto Rico

People are both consumers and producers. No plan would be complete which failed to consider the development of people in both of these capacities. People can consume more intelligently and produce more efficiently if they are well fed rather than malnourished, if they are literate rather than illiterate, if they are healthy rather than sick, if they live in solid houses rather than in shacks, if they have opportunity for simple, healthy recreation. These are the "standards" which were previously discussed as goals and to which the entire plan for resources development is directed. To attain these goals society must produce enough to allow certain of its members to practice medicine, to teach, to construct houses, to supervise recreation, or to protect life and property.

Health, Sanitation, and Domestic Water Supplies

In Puerto Rico the health problem is essentially that of any community insofar as it is closely associated with living standards, sanitation, and domestic water supplies. But it is complicated by the exceptionally low standard of living throughout the Island and by the tropical climate. The weather, which is warm the entire year, encourages the continual development and spread of parasitical and bacteriological diseases. It perhaps has also some influence on the vitality of the human body itself. The effect of low living standards and of insanitary conditions is evident in table 21, which shows comparative death rates in 1938 per 100,000 population for certain major causes of death in the United States, Puerto Rico, and South Carolina, the State which appears to have the highest death rates from causes of death which rank highest in Puerto Rico.

As a second principal development, "caravan stop" overnight motor tourist facilities might be established at such locations as Lares, Guajataca Reservoir, Mirichico National Forest, Coamo Springs, Aguadilla, Boquerón, and Vega Baja.

On the southwest coast is another area that holds possibilities for the development of larger and more intensive tourist facilities. This dry area, reminiscent of southwestern United States, might be developed with dude-ranch facilities complementing the recommended expansion of livestock-raising activities. The combination of western range and sandy sea beach should have definite tourist value. It is also possible that a smaller, mountain-type development might be feasible, near Aibonito, which has one of the coolest and driest climates in Puerto Rico.

THE PEOPLE

Express coastal highway connections with San Juan and Fajardo would be desirable, for a large fleet naval base is being established at Ensenada Honda near Fajardo, and the resulting concentration of continental in this area should make it a popular amusement center with enough business to warrant public improvement catering to continental standards.

However, while the automatic effects of the development plan are being realized, it would appear desirable to expand specific public health measures, insofar as society is willing to do so. For these measures—if designed really to increase the productivity of the individual—will in turn contribute to the earlier realization of the plan itself. Just what these specific measures...
Table 21.—Death rates per 100,000 population from selected causes, 1938, United States, South Carolina, and Puerto Rico

DISEASES PRIMARILY DUE TO LOW STANDARDS OF LIVING AND TO INSANITATION

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>United States</th>
<th>South Carolina</th>
<th>Puerto Rico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea and enteritis</td>
<td>14.2</td>
<td>36.4</td>
<td>415.5</td>
</tr>
<tr>
<td>Under 2 years of age</td>
<td>16.8</td>
<td>31.1</td>
<td>272.3</td>
</tr>
<tr>
<td>Over 2 years of age</td>
<td>3.4</td>
<td>3.3</td>
<td>143.2</td>
</tr>
<tr>
<td>Tuberculosis (respiratory)</td>
<td>4.7</td>
<td>46.2</td>
<td>285.5</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>87.0</td>
<td>88.0</td>
<td>129.1</td>
</tr>
<tr>
<td>Malaria</td>
<td>7.0</td>
<td>50.0</td>
<td>110.2</td>
</tr>
<tr>
<td>Syphilis</td>
<td>5.7</td>
<td>17.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Dysentery</td>
<td>2.2</td>
<td>5.5</td>
<td>11.2</td>
</tr>
</tbody>
</table>

OTHER DISEASES

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>United States</th>
<th>South Carolina</th>
<th>Puerto Rico</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease (except rheumatic)</td>
<td>222.2</td>
<td>158.9</td>
<td>101.1</td>
</tr>
<tr>
<td>Cancer</td>
<td>146.6</td>
<td>54.8</td>
<td>56.2</td>
</tr>
<tr>
<td>Cerebral hemorrhage</td>
<td>87.7</td>
<td>57.7</td>
<td>27.4</td>
</tr>
<tr>
<td>Angina pectoris (diseases of coronary arteries)</td>
<td>55.6</td>
<td>35.4</td>
<td>11.0</td>
</tr>
<tr>
<td>Accidents (other than auto)</td>
<td>47.0</td>
<td>40.6</td>
<td>22.0</td>
</tr>
<tr>
<td>Automobile accidents</td>
<td>20.5</td>
<td>24.5</td>
<td>8.7</td>
</tr>
</tbody>
</table>

should be both quantitatively and qualitatively, how they might be expected to affect the Island's morbidity and mortality situation, and how they can be paid for by the community should be determined by appropriate authorities and presented in a long-term program. In general they would include: (1) general health measures, (2) improvements in sanitation, and (3) improvements in domestic water supplies.

General Public-Health Measures

In the first place, Puerto Rico should be able to "afford" to initiate an intensive island-wide campaign to clean up and keep clean all places particularly attractive to the breeding of bacteria and parasites. These would include not only the public streets and squares but also stores, restaurants, cafes, and perhaps even private yards where filth endangers the health of neighbors as well as that of the occupants. Puerto Rico can afford this kind of health work, because it has unemployed labor available. If this labor were applied to the type of clean-up work here suggested, the productive facilities of the Island would not have to be increased; for this labor would have to consume food, clothing, and shelter whether it works or does not. Such an intensive public clean-up campaign might substitute for the private cleanliness which higher living standards would presumably induce. In doing so, it
might have an appreciable effect on the major causes of death in Puerto Rico, diarrhea and enteritis. The rate of incidence of these diseases is over 25 times that of the United States. Similarly, as long as there are unemployed but employable persons available, drainage of swamps and other measures to control malaria can be increased. For no great quantity of materials need be imported. Such disease-breeding swamps as those in which the El Fanguito slum in San Juan is built could be eliminated by draining, filling, and covering all open sewers.

On the other hand, the possibilities for building hospitals and supplying medical services in Puerto Rico are limited. Much of the materials and equipment for hospitals must be imported; all Puerto Rico's doctors and dentists must be trained elsewhere. For these goods and services Puerto Rico must exchange other goods and services. The latter can only come by increased production or by diversion. Under these circumstances, Puerto Rico could expand only very slowly its hospital bed facilities from the present 4.6 per 1,000 people to the 14.6 ratio which is needed, if the standards set for the United States by the Technical Committee on Medical Care are to be met. Similarly, Puerto Rico could only slowly increase the numbers of its doctors and dentists from the present ratios of 1 to every 3,500 people and 1 to every 13,000 people respectively to equal the ratios of 1 doctor to every 748 people and 1 dentist to every 1,870 people which prevailed in the United States before the war. It might appear simple to expand the supply of doctors and dentists in peacetime by "importing" them from the States, but these professional men would ask high compensation which could also be provided only by the increase in productivity or the diversion of existing goods and services.

Under all of these conditions the exact determination of standards or goals for developing definite health programs in Puerto Rico is perhaps the most difficult question. Under conditions existing in the Island, should public health measures which involve additional costs to the community be concentrated on the most promising sections of the community, thus assuring better attention to a relatively few of the potentially most productive members of the community? Or should they be spread over all the people in consequently insufficient amounts to affect appreciably the general level of energy, health, and alertness? Subsequent to the substantial decrease in death rate just after the American occupation, the death rate in Puerto Rico was further lowered by only 15 percent. Whatever the answer, a definite program in terms of both values and physical quantities is a prerequisite to any effective public health work.

Sanitation

In crowded communities sanitation and water improvements are basically important to health. If they are good, health conditions will ordinarily be good; if they are bad, health conditions will ordinarily be bad.

As has been pointed out, the Island's highest mortality rate is due to a group of clinical entities stemming from enteric parasitical and bacterial diseases, including diarrhea, dysentery and enteritis, which could be largely eradicated through proper public health measures, since polluted water and soil apparently are the chief sources of infection. Only 45 of the 77 towns in Puerto Rico have sewerage systems and in rural areas, where the population density is 380 persons per square mile, there are few facilities for the sanitary disposal of human excreta and practically no developed and protected water supplies. As a result, almost all surface water is contaminated with excreta, the source of uncinariais (hookworm), Bilharzia, and other enteric diseases from human carriers.

Several improvements can and ought to be made, without requiring much imported goods or services, simply by utilizing manpower and brains which are now being employed either ineffectively or not at all. A greatly expanded public educational program, with house-to-house visits, should be initiated to teach the need: (1) to prevent indiscriminate fecal deposits; (2) to eradicate rats and their harborage; (3) to dispose of refuse so as not to attract rodents and insects; (4) to require cooking of garbage before feeding to swine in order to prevent trichinosis. Responsible trained operators are needed in connection with most of the present sewage treatment plants; indeed, it is suggested that a training school be initiated so that present expensive sewage treatment plants (many of which were built partly with Federal funds) can be operated by qualified personnel. All too often, expensive installations are allowed to deteriorate too rapidly or are not operated efficiently simply because of ignorance and irresponsibility.

But basic improvements to existing sewerage services and the construction of new systems will also be necessary if the public health of the entire island is to be pro-
tected. The rapidity with which these things can be done is governed by the general limitations discussed above. These basic improvements, however, should not be undertaken unless adequate provision is made by the insular government to assure that they will be properly maintained and properly operated. They can be summarized as follows:

(1) Construction of sewerage systems in all towns which now have none and extension of present systems to include built-up areas without service. The latter is particularly important in San Juan.

(2) Construction of sewerage treatment plants in the larger towns and cities which now have none.

(3) Construction of completely new systems and treatment plants in Arecibo and Cataño.

(4) Extension of outfalls in Aguadilla, Camuy, Guayama, Ponce, and Santa Isabel. (In the last town the lack of such facilities has prevented the existing sewerage system from being used.)

A second type of improvement which does not involve great capital outlay is the control of pollution from untreated industrial waters discharged into streams from sugar factories and distilleries. These add to the cost of water treatment, increase the impurity of water where no treatment is available, and constitute a menace to aquatic life. Existing legislation should be enforced to have industrial establishments treat their wastes wherever present disposal practices are harmful to the health of humans, domestic animals, or fish.

Domestic Water Supplies

The need for good water for domestic use in any tropical country is self-evident. Impure water is considered one of the principal reasons for the Island’s high incidence of diarrhea and enteritis; 72 percent of Puerto Rico’s population consumes raw or untreated water. There are few water systems and no treatment plants in the rural areas. In some areas wells serve limited rural groups, but even deep well water is considered unsafe without chlorination. The use of cisterns is uncommon. The situation in towns is only slightly better; for, though every major town in Puerto Rico has a water-supply system, only 10 towns, serving a total of 463,000 inhabitants in 13 urban areas, have water-treatment plants. Of these, in turn, only 1 water-supply system consistently meets the bacteriological requirements of the United States Public Health Service drinking water standards. This poor showing is due in some instances to inadequate chemical treatment of water and in others, even where chlorinators are installed, to improper operation because competence is not demanded by the community. For example, 100 percent of the samples of water taken during 1941–1942 in three towns whose supply is supposed to be chlorinated, showed presence of B. coli.

As in the case of sanitation desirable improvements in water supplies can be considered in two categories. In the first are several improvements whose material cost are not great. They are:

(1) Adequate training and supervision of all water-treatment plant operators. This is most important if large capital investments are not to be wasted.

(2) Preparation and enforcement of a well-construction code to protect both individual and public underground water supplies.

(3) Rehabilitation of old cisterns and construction of new ones. In this connection, no public rural housing should be built which either by cisterns or otherwise does not provide a pure water supply at least for drinking purposes. This is discussed below in the housing section.

Other types of improvements indispensable for assuring pure water in areas of high population density require considerable amounts of imported materials. They are:

(1) Water systems for built-up communities which now have none. For, although all cities or “towns” have such systems, many villages are equally in need of them.

(2) Almost every town whose water system does not include a treatment plant should be provided with either an adequate treatment plant or chlorinators. One group of towns already have either treatment plants or chlorinated water from deep wells or springs. Another group needs only chlorinators, because their sources are deep wells or springs. All other towns in Puerto Rico need complete treatment plants.

It will be noted that only the first recommendation is concerned with the distribution of water. The other recommendations concern only its purity and would have to be carried out whether the water were distributed by pipes to each house or were transported by each homeowner in cans.
Development Plan for Puerto Rico

Estimated costs of providing water-treatment plants in Puerto Rico are as follows:

<table>
<thead>
<tr>
<th>Plant capacity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 million gallons per day</td>
<td>$75,000</td>
</tr>
<tr>
<td>½ million gallons per day</td>
<td>50,000</td>
</tr>
<tr>
<td>¼ million gallons per day</td>
<td>30,000</td>
</tr>
</tbody>
</table>

Where entirely new sources of water supply are needed, it is estimated that the average cost of developing each source would be $40,000. This excludes, however, cities of the size of San Juan, Ponce, and Mayagüez, where costs would be higher.

For rural water supplies it has been estimated that a drilled well could serve between 50 and 100 people at an average cost of $600 per installation. Shallow wells, cisterns, and springs might each serve about 50 people, at an average cost of $150 for each development. An extensive well-drilling campaign might be started at once for it would require relatively little strategic materials. To provide for adequate water treatment, new water supply developments, and needed repairs to existing supplies in urban areas would probably cost about $8,500,000, and to provide adequate water supplies for rural areas would probably cost $8,400,000. The estimated total cost would therefore be nearly $17,000,000. These estimates include developing the water supplies sufficiently to care for normal population increases over a period of six years.

Education

No one questions the fact that education is essential to the full development of any community, not only to a well-rounded community life but also to maximum production. Education is almost the answer to the entire problem of the Island. For, until educational standards are raised, it will be most difficult to carry out programs for increasing intensity of land use, industrialization, or public health standards. As table 22 shows, Puerto Rico has long realized this fact and has made good progress in educating its people.

Table 22.—Percent of total population of Puerto Rico 10 years of age and over who are literate and who speak English, selected years, 1899-1940

<table>
<thead>
<tr>
<th>Year</th>
<th>Percent literate</th>
<th>Percent able to speak English</th>
</tr>
</thead>
<tbody>
<tr>
<td>1899</td>
<td>20.4</td>
<td>9.2</td>
</tr>
<tr>
<td>1910</td>
<td>33.3</td>
<td>14.4</td>
</tr>
<tr>
<td>1920</td>
<td>45.0</td>
<td>19.9</td>
</tr>
<tr>
<td>1930</td>
<td>58.5</td>
<td>36.7</td>
</tr>
<tr>
<td>1940</td>
<td>68.8</td>
<td>38.7</td>
</tr>
</tbody>
</table>

In the past 40 years Puerto Rico has expanded its educational facilities many times more than any State of the United States. Yet it has only increased the number of its population between 5 and 20 years of age attending school from 30 to 40 percent over a period of 30 years or by one-third of 1 percent a year. That Puerto Rico has thus still so far to go is partly explained by its continually increasing population; Puerto Rico must educate a much higher percentage of its population than any State on the continent. Another reason why Puerto Rico has not been able to reach the standards which prevail on the continent is, of course, that it has not been able to afford to assign to education as much money as other States and Territories. Under these conditions, it is not surprising that in Continental United States 84.4 percent of the population from 5 to 17 years in 1938 were enrolled in public schools; whereas in Puerto Rico in 1940 the percentage was only 48. In 1940, 31.2 percent of the population of Puerto Rico 10 years of age and older were illiterate, in the Continental United States, 6 percent, the highest illiteracy rate being that of Louisiana, 21.9 percent.

Table 23 is of some value also in indicating the magnitude of the problem of financing public schools in 1938.

Table 23.—Per capita expenditures for public schools, Hawaii, Puerto Rico, and United States, 1938

<table>
<thead>
<tr>
<th></th>
<th>Per capita of total population</th>
<th>Per child enrolled (for current expenses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hawaii</td>
<td>$77.00</td>
<td>$25.50</td>
</tr>
<tr>
<td>Continental United States</td>
<td>$77.00</td>
<td>$25.93</td>
</tr>
<tr>
<td>Lowest States</td>
<td>(Miss.) 9.83</td>
<td>(Ala.) 7.05</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>4.55</td>
<td>25.97</td>
</tr>
</tbody>
</table>

Although accurate figures are not available, what data there are indicate that, in spite of its great educational needs, Puerto Rico does not spend so high a percentage of total Insular and municipal expenditures on education as does the average State. Much has been said about bilingualism in Puerto Rico, but certainly the basic need is simply that of more education.

The Department of Education, in full knowledge of these needs, has outlined a definite program for expansion, as has also the Special Commission to study the problem of children without schools, established by act of the legislature. A special census conducted by the Department of Education in 1942 indicated that of 280,466 children between the ages of 5 and 19 not in school, 121,170 had never been to school at all, and 119,289 had dropped out before completing the sixth grade.

The basic program presented by both the Department and the Commission is to provide teachers and facili-
ties so that each one of these children may be given at least six years of elementary education. This modest program would require, however, an additional 5,000 elementary school teachers with annual salaries averaging $1,082; 5,000 schoolrooms at an average cost for land and buildings of $3,200; and expenditures of $3.70 per pupil for supervision, equipment, administration, maintenance, and similar expenses. If the program were spread over a 10-year period, its costs would be:

- Annual amount for construction and land...$1,600,000
- Additional annual amount for teachers (increasing arithmetically each year until it reaches an ultimate annual total of $5,160,000)...$516,000
- Additional annual amount for maintenance, etc. (increasing arithmetically each year until it reaches an ultimate annual total of $740,000)...$74,000

As the budget for education is at present about $9,000,000, this basic program would mean a 66-percent increase within 10 years for the continuing expenses, or about 7 percent a year, plus carrying charges and amortization, for the permanent improvements. This does not seem impossible of fulfillment. To it, however, must be added approximately another 2 percent to take care of the net increase in population.

This, of course, is a minimum program. The Department of Education feels that facilities for education after the sixth grade should always keep ahead of enrollment in the lower grades, so that the students may be encouraged to proceed up the educational ladder. The above program does not include special equipment for vocational training, expansion in high-school facilities, or educational opportunities for special classes of the population, such as illiterate adults, physically handicapped children, defense workers, and so forth, or for special services such as school-lunch programs. These facilities and services could be and have been planned and programmed, and their costs estimated; but it is felt that the primary job for public education in Puerto Rico is to guarantee at least six years of school for its coming generation of young people. The Department of Education is also aware that, with its funds so limited, every penny should be spent on the type of education which will best prepare the boys and girls of Puerto Rico for the world they must live in. The advance constituted by this approach is evident from the following official statement of policy:

"Formerly, the directive personnel of the school system prepared in advance the material to be taught in the different subjects—elementary science, social science, and physical education—and the teacher taught this subject matter without considering its function as an aid in solving the pupils' problems. Sometimes it was useful material; many times it was superfluous."

The newer philosophy states that "One of the fundamental aims of the school is to guide the students in the solution of their own personal problems and those of the community. * * * Some problems affect the whole group, and their solution requires joint action: public sanitation and cleanliness, contagious diseases, crime, unemployment, overproduction, and the like. A greater participation by individuals in the solution of those problems common to society will lead to a greater feeling of civic responsibility by the group and, thus, to the greater effectiveness of our representative form of government."

These are the factors which throughout this report have been considered as the keystone of the entire problem. If the coming generations are taught to recognize them, half the battle will be won; if they are taught to solve them, real victory is assured.

Housing

As in most Caribbean countries and in certain sections of the Continental United States, the majority of families in Puerto Rico live in houses which are definitely below any tolerable standard for human beings. Of the 355,000 family dwelling units in Puerto Rico in 1940, nearly 90 percent had two or less sleeping rooms, and it is estimated that at least 75 percent of the dwellings, or 270,000, were substandard and should be replaced. In addition to this, the normal population growth in Puerto Rico, 33,000, is equivalent to over 6,000 families averaging 5.3 persons each, requiring that many more housing units each year. In urban slum areas about 25 single-story wooden shacks are customarily crowded onto a single acre. As the average family is composed of about five members, this means a net density of about 125 persons per acre. There are usually no community facilities, playgrounds, or schools within these vast slums. Water is supplied by public faucets, and sanitary facilities usually consist of makeshift latrines. Perhaps in the larger towns both public and private multiple-story housing might be encouraged, thus saving land area for recreation and other uses and reducing the cost of utilities. The rural housing problem, both qualitatively and quantitatively, is even more acute than the urban, although the slum areas of the towns have been given much greater public attention. Privately financed housing reaches only the upper income group, and while Puerto Rican and Federal Government agencies, particularly the Puerto Rico Reconstruction Administration, and the local Housing Au-
Development Plan for Puerto Rico

authorities with the assistance of the Federal Public Housing Authority and the Farm Security Administration, have carried out comparatively large-scale low-rent urban and rural housing programs, the number of units built annually has not been sufficient to house even the annual population increase, to say nothing of the backlog.

Urban housing conditions are graphically reflected in one of the few studies that have been made in this field. San Juan is the example cited, but similar conditions prevail in all the towns of the Island.

Unfortunately, houses are frequently constructed clandestinely. Overnight and entire developments of shacks have emerged almost one on top of the other. In that way the belt of slums which almost surrounds San Juan has been built: La Perla, in the north, Miranda, Miraflores, Hoare, Tras Tallores, La Zona, Melilla, Marina and San Giprian in the south bordering the harbor, and the Martin Peña channel up to Shanghai in the San José lagoon at the east of San Juan.

The houses in these slums are of the worst type; of frame construction and roofed with galvanized iron. Very frequently the houses are constructed with debris and with wood taken from crates of automobiles, furniture, etc. Occasionally, one finds a house of better construction but this is very seldom. The appearance of these slums is gloomy and miserable. All of them with the exception of La Perla and Alto del Cabro are constructed in low and swampy land bordering the harbor or the Martin Peña channel.

Rural and semirural housing conditions are accurately described in a report of the Puerto Rico Reconstruction Administration:

There is not much variation in the type of houses commonly encountered in the rural districts of Puerto Rico. They are small, simple, fragile, and the fact that, as a rule, they are unpainted, imparts to them a peculiarly shabby appearance. The typical house is the common gable roof frame house covered with galvanized iron, although a considerable proportion of them are constructed, or at least roofed, with straw or yaguaras. Not much difference exists between the bohio [a straw or yaguaras hut] and the small frame house from the sanitary point of view. Certainly, the bohio is liable to attract a large number of insects which may be dangerous to health, but, on the other hand, it is cheaper and cooler for the Tropics and has the same accommodations as the frame house. In many of the houses, especially in the sleeping rooms, there are no windows. There is sometimes an opening in the wall which is usually covered by rudimentary blinds made of used bags or clothes as a protection against the weather. In the frame houses numerous crevices and holes, through which the air enters freely, are often seen in the walls and floor. This, in many respects, is a blessing for these people who live crowded in the houses and sleep with the windows—when there are any—tightly closed.

Except for keeping the occupants warm in winter, a house in Puerto Rico has the same functions as elsewhere. Basically it should:

1. Protect individuals from wind, rain, and sun. The physical structure can be very simple, but should be reasonably substantial in order to fulfill this purpose.

2. Make provision for pure water, sanitary disposal of feces, and sufficient light and air. Water, sanitation, and space can be assured in urban areas by land and utility projects. In many rural areas cisterns for drinking water and privies are sufficient, although in others, particularly where rainfall is inadequate, wells may have to be developed.

3. Provide privacy for the family and, within the house itself for its individual members.

The first function is the protection of the individual from the elements; the second is his protection from diseases; and the third, the development of a stable and responsible family life. Together these are the simple standards which should guide the program of any housing development in Puerto Rico. Together with education and health programs, they form the basis of development for the Island’s most important resource, its people.

The realization of a program to assure such housing facilities is difficult to achieve even under normal peacetime conditions because of the costs of imported construction materials. Under wartime conditions the difficulty becomes much greater. Yet there are certain things which could be done under war conditions to improve housing for the masses. These are:

1. Use of local materials and unemployed labor for an immediate housing program, particularly for rural areas. Cement is becoming available as defense construction stops; meanwhile bamboo, adobe, rammed earth, and stabilized earth for housing would require few imported materials. Research into the use of local materials should be continued. If an adequate low-cost house can be developed by the use of local materials and simple construction methods, housing might become a war emergency program second only to education in importance.

2. Development of land and utility projects on the periphery of existing towns to absorb newcomers, and the provision for the new communities being created under the Land Law. Such projects can be considered adequate temporary stop-gaps. They use a minimum of imported materials per family unit.

25 Marcel A. Pérez, Preliminary Study of Living Conditions in the Slums of San Juan, Puerto Rico Reconstruction Administration, San Juan, P. R., March 1939.

The first project of this character was erected in Aguadilla after the earthquake and tidal wave of 1918.
3. Stabilization of urban areas through zoning and the advance acquisition of land for post-war developments. It is important to determine where housing for low-income families should be encouraged and where it should be discouraged. Zoning can demarcate districts where topographical conditions are satisfactory and where facilities such as water and sewer systems exist or can be economically extended. Certainly the present density of housing on speculatively held private land should be discouraged in future construction.

After the war the more complicated job of rebuilding in urban slum areas could be undertaken. Perhaps rebuilding generally could then be encouraged by Government purchase and sale of simple, standardized building materials to any one wanting to build his own house, but the great bulk of the needed new buildings will presumably have to be publicly financed and operated. The introductory sections of the plan discuss the extent to which this may be feasible; from the point of view of need there is practically no limit.

Community Facilities and Recreation

Though the people of Puerto Rico are friendly and sociable, the consciousness of the community—as distinct from that of the family unit—has been slow to develop. The inevitable central plaza of every town and its dominant church, a few baseball fields, cock galleries, and movie houses are the principal physical centers for community life. There are few local playgrounds, no developed public beaches, and few libraries. The cities themselves, having long lost the simple pattern prescribed by the Council of the Indies, are often scattered in a more or less heterogeneous, unrelated grouping with no real neighborhood centers. Yet community living is desirable as a social, stabilizing force anywhere and appears to be gaining in importance. Some of the above suggestions may involve attitudes which cannot easily be changed; but, in the planning of whatever public improvements are made in the future, the encouragement of more cohesive communities should be considered as a prerequisite for the accomplishments of any planned development for the Island. New streets, street widenings, agregado settlements, school design and location, and urban zoning can be so conceived as to encourage the development of natural communities without the expenditure of additional funds.

While the importance of recreation itself to the well-rounded life of the individual and the community is fully recognized, the many pressing health, dietary, and sanitary needs call for precedence in the careful expenditures of limited financial resources. Recreation should be designed principally for children and adolescents to include playgrounds for small children in crowded residential areas and open basketball and baseball recreational areas or "savannahs" for adolescents in less congested areas. Adult recreation could well be limited until more funds are available for the development and rehabilitation of the central plaza in each of the various municipalities as a passive type of social center. Public beaches ought to be established in many localities, though they need not be intensively developed, requiring mainly provision for cleanliness and easy access.

Social Security

Though the basic purpose of a development plan for the resources of any community is the ultimate welfare of all its members, no development plan can expect to cover each individual in every group within it. Total production by the group may be increased as planned, resulting income may be fairly distributed among the community’s members in direct remuneration for their efforts, and income may also be redistributed through the various special services such as health, sanitation, education, housing, and recreation as outlined above. Yet, although all of these programs may be fully realized, there will still remain some members of the community who will be “left out.” There will be some who will not have enough food, clothing, and shelter. These people may be categorized as those who are temporarily unemployed, aged, dependent because of their youth, sick or disabled (but not covered by other health programs), or the victims of so-called “acts of God.” Others may not be so classified; they may simply be human beings who, for any reason, are in hunger or want.

The problem of social security has for many centuries and in many lands challenged man’s best efforts. In the United States and England the efforts to attain security can be traced back over centuries to the Poor Laws; today they may be seen in the recommendations of the National Resources Planning Board, the Social
Security Board, and Sir William Beveridge. Puerto Rico's social-welfare programs have in the past been based almost exclusively on institutional care. Except for a brief period in the thirties when Federal funds were available, Puerto Rico has not had either an Insular or local direct relief program, and its participation under the Social Security Act has been limited to the provisions of Title V, Grants to States for Maternal and Child Welfare, and Title VI, Public Health Work. The principal reason for this was, of course, the very low income of the great majority of the Island's population.

Nevertheless, an expansion of its social-security programs should be outlined, since, even with the general increased productivity which the development plan attempts to provide, there will still be individuals in need. Specifically the expansion should eventually embrace existing institutional programs and measures for the temporarily unemployed, the aged, dependent children, the sick, and the disabled. The legislature at its last session made an important step forward in this direction by passing the Public Welfare Act of Puerto Rico to coordinate and expand social-welfare measures in Puerto Rico. This act was based on recommendations of a special Commission which presented the estimates of present needs shown in table 24.

**Table 24.—Estimated extent of need for public aid to unemployed persons, Puerto Rico, 1942**

<table>
<thead>
<tr>
<th>Type of case</th>
<th>Estimated number needing aid</th>
<th>Estimated maximum assistance</th>
<th>Resulting annual cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aged</td>
<td>25,000</td>
<td>$40</td>
<td>$960,000</td>
</tr>
<tr>
<td>Blind</td>
<td>3,000</td>
<td>12</td>
<td>36,000</td>
</tr>
<tr>
<td>Needy children</td>
<td>35,333</td>
<td>18</td>
<td>635,000</td>
</tr>
<tr>
<td>Other needy children</td>
<td>65,666</td>
<td>12</td>
<td>788,000</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$3,500,000</td>
</tr>
</tbody>
</table>

1 These amounts are specified in the Social Security Act (Titles I, X, and IV) as the maximum amounts of which the Federal government will pay one-half.
2 Under Title IV (Aid to Dependent Children), the Federal government will pay one-half of a grant of $12 for each child, and one-half of a grant of $24 for each dependent child in the same home.
3 As much as $12 for each other dependent child in the same home.

In addition to the unemployed groups shown in table 24 there are probably 22,000 who are unemployed for other causes. There are also the unemployed, perhaps 175,000 to 250,000 persons. These estimates do not include unemployment insurance or old-age insurance. On the other hand the $40 a month used in these calculations is a much higher figure than it would be reasonable to suppose would actually be adopted. It is the large group of unemployed and underemployed for whose employment and expanded income this plan attempts to provide. But on behalf of all these groups of people in want, a centralized, well-administered social-welfare agency, with adequately staffed field offices working on a sound program, is important. Care should be taken that, as long as there is useful, productive work to be done by the people of Puerto Rico, no idle man should be allowed to gain his livelihood through direct relief. Otherwise, marginal lands can never be cultivated nor marginal enterprises be undertaken, and these constitute the very core of many of our programs.

In summary it is proposed that:

1. Public work should be made available for all employable persons who cannot obtain private jobs. Such public work might well be used both for producing wealth and as a technique for distributing it equitably. It is imperative that expenditures for public work follow a carefully developed and coordinated plan for the enhancement of the Island's welfare. To spend public funds on a miscellany of unrelated projects may mean wasteful duplication and the sacrifice of wide-spread lasting benefits.

2. General programs for developing human resources as outlined in this plan should be developed in the fields of health, sanitation, housing, and recreation.

3. Insurance for employables should be provided when, for reasons beyond their control, they cannot secure employment and after their working days are over.

4. General relief or special assistance to the blind, the needy children, or the aged should fill in other gaps.

**Government**

The development plan outlined herein is based on Puerto Rico's resources of land, labor, and capital, but to secure the best use of these resources, efficient government is also required. For this reason it is desirable to enumerate some of the problems involved.

**Federal-Insular Governmental Relationships**

Relationships between the United States and Puerto Rico are perhaps the most important governmental problem. The future possible status of Puerto Rico as related to the continental United States has been discussed in the introductory sections of this report.

**Fiscal Administration**

Associated with Federal-Insular problems, but also a matter of purely local concern, is the question of fiscal administration. Generally, it would appear that the entire revenue structure for Puerto Rico and its municipalities could be greatly simplified and made more flexible. The latter is necessary as government revenue

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policies play an increasingly important role in stabilizing the Island’s economy. Although great improvement has been made in budgeting of expenditures, trust funds have still to be brought within the total fiscal presentation. Details of fiscal administration, including accounting for funds, assessment procedures, and separation of auditing from executive decision, could be perfected.

**Personnel and Business Administration**

Personnel and business administration are probably as weak links as any in the governmental mechanism of Puerto Rico; yet without good personnel practices governmental agencies can operate only inefficiently at best. A progressive recruitment, examination, and training policy, at least for all Insular employees, is greatly needed. The mechanism for government purchasing should likewise be brought up to date.47

**Coordinated Planning**

Coordinated planning, whether at the municipal or Insular level, begun in Puerto Rico less than a year ago by the Insular Planning Board, has already shown great progress. Yet unless plans are made for both private and public development, services, and facilities, unless at least the public portions are related to each other and programmed in time, and unless the plans are kept up-to-date and enforced, neither this plan nor any other will be significant. Planning is not something which can be avoided; it will always be done, though it may be done very badly or very wisely. Bad planning indeed, is partly responsible for the present maladjustments in Puerto Rican life, and the Island’s expanding population can no longer afford it.

**Public Buildings**

The need for central administrative buildings in San Juan and elsewhere throughout the Island will expand as government expands. Unless an orderly plan is drawn up for the solution of over-all government space needs, each agency will solve its own needs as it can and as it sees fit, without relation to the needs of the others. In a rational urban plan, government, like other specialized activities, needs its own location within a frame of community life. The old Spanish and European concept of a town plaza or square surrounded by public buildings hews close to rationality and may point the way to a solution of the present needs in San Juan.

In the case of San Juan it may be desirable in the final plan to establish three government centers:

1. Old San Juan, containing Federal offices connected with harbor activities, La Fortaleza or governor’s residence and offices, the Capitol, historic
cal museums, and perhaps the center of Army and Navy activities. The old city will probably continue to be the wholesale, financial, and shipping center.

2. Santurce, containing the center of the executive branch of the Insular Government, public corporations, a library, an Insular theatre, and Federal agencies.

3. Río Piedras, containing the center of educational and cultural activities, the University, the Experiment Station, and other offices of the United States Department of Agriculture.

In the design of buildings for the government, the participation of engineers, planners, and architects in the Americas might be encouraged by means of a Pan-American Design Competition whose purpose would be to develop functional site plans and building types expressive of the needs of a tropical capital. The growth of a rich regional idiom such as has been developed in Mexico should also be fostered. Design should make full use of local materials such as concrete, brick, tile, stone, hardwoods, fibre insulation; local and regional talent in mural painting, sculpture, and furniture design; and tropical plants and trees.

**Police Protection**

Puerto Rico, like Spain and most Spanish-American countries, has relied principally on an island-wide rather than municipally controlled police service—the Guardia Civil before 1898, the Insular Police Department today. The Island is now divided into 9 zones, each with a main station in the principal town of the zone, and there is a further subdivision into districts, each usually composed of one municipality. The regular police force in Puerto Rico numbers 1859 men, including patrolmen and officers. There are only 10 civilian police department employees, the majority of the clerical work being done by policemen. The ratio of police employees per thousand inhabitants is 0.84, and per thousand urban inhabitants the ratio is 2.77. The latter figure is considerably higher and the former considerably lower than a similar ratio for cities in the United States, 1.83 per thousand,48 but it should be remembered that the Insular Police Department is both urban and rural in scope.

By comparison with cities in the South Atlantic States, the police forces in Puerto Rican cities are inadequate in numbers. San Juan, with a population of 169,247,49 has 344 policemen or 2.03 per thousand inhabitants, while Jacksonville, Fla., with a population of 173,065 has 262 (including 6 civilian employees) or

47 A new act passed by the legislature in 1943 may accomplish this.  
48 Figures for the United States are from national police records for 1940.  
49 1940 population census figures are used.
1.51 per thousand. Caguas, population 24,377, has 38 or 1.56 per thousand, while Rocky Mount, N. C., with a population of 25,568 has only 33 police department employees or 1.39 per thousand. However, Ponce, population 65,182, has 83 or 1.28 per thousand compared to Augusta, Ga., population 65,919, which has 126 police and department employees or 1.91 per thousand. Puerto Rico has 4,300 auxiliary police, a ratio of 2.3 per thousand, which is lower than the average of 3.19 for the United States. The total of regular and auxiliary police bears approximately the same ratio to population as the total of both forces does in the States, 5.1 per thousand.

Case registration and criminal investigation procedures are in accordance with good practice in the United States, and many of the personnel have received training on the continent. However, the police department is in need of new station houses throughout the Island, particularly in the small towns and rural communities.

Fire Protection

Unlike police protection, fire protection has been until recently organized on a local basis and has been rather limited in equipment and trained personnel. To remedy the situation, an Insular Fire Department has been organized within the last year in the hope that more centralized services might be able to afford the heavy investments which are unwarranted for each small municipality.

In a survey made by the Office of the Superintendent of Insurance of the Insular Government in 1941, it was pointed out that, of a total of 77 municipalities, only 18 had full-time or volunteer fire departments; of these, only 8 had pumper trucks. In the whole island there were 13 pumper trucks and 6 city trucks. According to standards established in the United States by the National Board of Fire Underwriters, the cities of Puerto Rico, on the basis of their population and number of multi-storied buildings, should have a total of 106 pumper trucks and 14 ladder trucks. It is not necessary to regard the standards set in the United States as binding for Puerto Rico, since different conditions prevail; industrial fire hazards are lower, and the lack of heating systems reduces the hazard in private houses. These standards are of value, nevertheless, as a yardstick for comparison, in the absence of standards more applicable to local conditions. San Juan, with a population in 1940 of 169,247 and an assessed property valuation one-fifth of the total for Puerto Rico, had two pumper trucks, no city trucks, and only 26 full-time firemen. San Juan should have at least 12 more pumpers and 6 city trucks. The city of Ponce (population 65,182) had 2 pumpers and 2 city trucks for its volunteer fire department. Mayagüez (population 50,376) had 3 pumpers and 1 city truck. Apparatus belonging to the Army has been available for fire fighting in cooperation with the city department, but in any emergency the Army’s responsibility is naturally for its own establishments. Fireboats, or at least barges equipped with fire-fighting apparatus, should be provided for the principal harbors, especially that of San Juan. Incidentally the improvements to the water systems suggested herein should contribute toward the attainment of an adequate fireflow in quantities recommended by the National Board of Fire Underwriters.

The new Insular Fire Department has acquired a limited amount of equipment for emergency use and has begun its training program. As conditions permit, new apparatus will be purchased. It has been suggested that, since the fire department now has the same territorial organization as the insular police, the fire stations needed could be built to house both police and fire department personnel and equipment, thereby reducing building costs and increasing the coordination and cooperation which will be necessary between the two departments.

People and Resources in Equilibrium

That people and their resources may be in equilibrium is the goal of every society. This equilibrium, however, need not be static. It can advance as science and technology, education and social responsibility—and in some societies, war—increase the opportunities for adjustment at a high level. Through such programs as health, education, and better housing the human resources of Puerto Rico can and should be developed so that they can contribute to the expansion of production. But it has been indicated as doubtful that production will be able to overtake population. If this is true and if it is considered really desirable to attain the minimum standards of living, then it would appear that population itself might be directly affected. It is no more rational to consider population trends fixed than production trends; both are subject to reason.

Emigration

Emigration is one of the oldest methods of easing population pressures and the only immediate solution. In the past great numbers of people have migrated across the face of the world, some as individuals and others as members of groups. Earlier migrations to the New World were of the latter variety; later migrations were of the individualistic character. Yet it is doubtful just how effective migration really is in affecting population trends in the home country. Some authorities believe that the decrease is only a stimulus to ever-greater reproduction. At any rate, emigration
in the past has usually been motivated either by a desire to escape from economic restrictions and political or religious persecution, or by willingness to risk personal hardships for the possibility of great riches. In Puerto Rico economic necessity has never reached the starvation level of Ireland in 1846-47; nor is there any such political or religious reason for emigrating as those which forced the Pilgrims from their insecure refuge in Holland in 1620. Indeed political situations in certain Latin American countries actively discourage Puerto Rican emigration to them. Nor are there as many really rich new lands to plow or to mine as there were when the Spanish settled so much of the New World, including Puerto Rico itself.

The present cost of resettlement in virgin areas under conditions which offer satisfactory chances of survival and success is rather high—perhaps between $2,000 to $3,000 per family. Hence, if Puerto Rico's net annual increment of 6,000 families was in any single year to be resettled, the cost would be between $12,000,000 and $18,000,000. This is a figure far beyond the Island's ability to meet.24 The few previous mass emigrations of Puerto Ricans to work in Hawaii and Arizona were not particularly successful. However, a carefully managed program for individual migration from Puerto Rico to the States might be adopted. This should certainly be done during the war when labor is needed on the Continent and there is a surplus on the Island. It should be carefully managed. During the war Puerto Ricans might either be recruited, transported, and put to work by the Federal Government on a labor-corps basis; or, if the worker is hired directly by private employers, employment contracts involved might be supervised by the Government. In general, however, the situation contains few elements which would make any large movements of Puerto Ricans probable.

Education

Education is a second way of deliberately trying to stabilize the family and level out population curves, just as it can also be used to encourage earlier marriages and a higher birth rate in those countries whose policy is one of expansion. An informed people realizes the relationship between population and resources; it knows that smaller families may be neces-

sary if each member is to be given full opportunity in the world. This kind of education, of course, embraces the school, but also goes beyond it. Such education should include consideration of the student and his community; but it should also be carried on by newspapers and the radio, by extension agents and social workers, at whatever points public opinion is moulded. Such a conscious program would be of inestimable value, and it cannot be overemphasized.

Birth Control

And, finally, child bearing itself can be guided, so that the children brought into the community may be better provided for and may themselves be better able to contribute toward society's productive effort. This policy would involve spacing births through later marriage, continence, or contraceptive practices. National law25 prevents the use of contraceptives in the District of Columbia and the Territories, but a favorable Federal Court decision has approved a local law to permit the giving of birth control advice and materials if necessary for health. The latter concept, however, is capable of rather wide interpretation in any tropical country, where living standards are extremely low. In Puerto Rico work in their fields was initiated several years ago by a private welfare agency and in 1939 was taken up by the Bureau of Maternal and Infant Hygiene of the Insular Department of Health. Although its work has been partially restricted by law and its funds and personnel limited the case load of reporting mothers has risen to 36,000 in 1942. Each case is fully documented and carefully followed up, and the education of the mother is considered of equal importance with, if not of more importance than the actual supplying of contraceptive material.

No cost estimates are available, but if it is assumed that one-quarter of the entire expenses of the Bureau can be directly or indirectly attributable to this program, the annual cost would be approximately $7.50 a case. It is not supposed that anything like full coverage of all "health" cases would in practice be desirable, even if feasible, but a continued expansion of the present work by 10,000 to 20,000 cases a year should be possible, at an annual increased cost of $75,000 to $150,000, attaining an eventual annual total of only $1,550,000 for 200,000 cases.26 This would indeed be a very small sum to pay annually for the stabilization of Puerto Rico's population long enough to allow other more basic factors such as increased living standards and universal education to affect the birth rate. It would require

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24 The Brookings Institution, Refugee Settlement in the Dominican Republic, Washington, D. C., 1943, gives some significant figures. "To resettle and reestablish substantial numbers of impoverished people will require large sums of money. The present cost of settling 500,000 persons abroad was placed somewhere near 2 billion dollars, or almost $4,000 per settler. Estimated repair costs of settling limited numbers of refugees in the Argentine and in Rhodesia exceed this figure. Palestine costs range from $3,500 to $6,000 per settler. ** This total underestimates expenditures of June 1943, according to round figures supplied by the settlement administration, were about $650,000, including $110,000 transportation costs paid by another agency. ** If the cost is prorated among the men, it would be close to $3,000 per person. This is, of course, a very rough measure to unit cost, but it is one that tends to underestimate rather than overstate the actual cost."

25 U. S. O. Ttitle 18, Chapter 13, Sec. 512.
26 There are approximately 250,000 married and consensually married women in Puerto Rico between the ages of 15 and 44.
however, careful selection and training of the specialized nurses who are so important an element in the success of the bureau’s efforts. It is assumed that such a program of birth control would be positive, not negative. A proper encouragement of births is as important as their limitation.

A positive program of education and birth control should be given considerable emphasis, for any reduction in the trend of population increase will allow the more basic effects of increased living standards to aid in stabilizing population at an optimum relation to resources.

INCOME DISTRIBUTION

As indicated in the introductory sections, there is, in addition to the securing of help from the outside, the expanding of production, and the adjusting of population, a fourth way to increase the standard of living; i.e., through better income distribution. (It must be clearly understood, of course, that no manipulation of income payments will increase the community’s total wealth by a single penny or a single cane stalk.) It is most difficult, however, to analyze objectively this fourth possibility in Puerto Rico, because the data on which any sound reasoning should be based simply do not exist. No reliable information, for instance, is available regarding even the Island’s total income and none at all regarding its income groups. Such facts as are available will, therefore, simply be set forth for the purpose of stimulating further research and of letting each interested individual draw whatever conclusions he may feel are justified.

Puerto Rico’s total income for 1942 has been estimated by responsible agencies at between $357,000,000 and $365,000,000.4 A rough approximation can also be secured by: (1) Adding the salaries, wages, and entrepreneurial income of all agricultural production, manufacturing production, and all government expenditures in the Island, on all of which fairly satisfactory data are available, and (2) estimating the value of other services, dividends, and interest by employing ratios similar to the average for Alabama, Georgia, and Mississippi. The significant figures follow for 1942, fiscal or crop year:

(a) Gross value to farmers from all agricultural production, excluding AAA $110,000,000
(b) Of which an estimated 75 percent constitutes salaries, wages, and entrepreneurial income in cash or in kind $82,500,000
(c) Federal expenditures in Puerto Rico for local (not national) benefit including AAA 62,154,000
(d) Of which an estimated 70 percent constitutes salaries, wages, and AAA payments 43,508,000

(e) Other Federal expenditures in Puerto Rico, including Army and Navy, construction and civilian personnel, customs, Post Office, etc., for wages and salaries only 16,000,000
(f) Insular Government disbursements 62,174,000
(g) Less Federal funds included in (e) 17,166,000

(h) Of which net total, an estimated 70 percent constitutes salaries and wages 31,506,000
(i) Municipal disbursements not reflected in (f) 2,352,000
(j) Of which an estimated 70 percent constitutes salaries and wages 1,676,000
(k) Value added by manufacturing (1939) 35,219,000
(l) Less dividends, interest, rent, depreciation, taxes, insurance, advertising 20,289,000

(m) Leaving for wages, salaries, and entrepreneurial payments 14,930,000

(n) Salaries, wages, and entrepreneurial income from agriculture, manufacturing, and government 189,120,000
(o) On same basis as 3 southern states “e” represents 33 percent of total income, remainder being produced in services, distribution, loan of capital, etc. So total income estimate for 1942 is 356,800,000

Is any income figure of approximately $350,000,000 a reasonable one for Puerto Rico during the fiscal or crop year 1941-42? It would appear at first study as too high; for it is equivalent to an income of $1,000 per family and $187 per capita and, if perfectly equally distributed, would indicate that Puerto Rico at least in this one year produced enough goods and services to give to its people the minimum standard of living discussed above. This contradicts both the general informed

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4 George L. Holliday, Other Problems We Face, Homemaking Newsletter, Insular Board for Vocational Education, September and October, 1942, p. 19.
opinion and the impression which even a casual visitor would secure from a trip through the Island or into the slums of its cities and towns.

The authors are aware of no other figures or even estimates by responsible agencies which could be used to correct the estimate here very tentatively proposed. On the other hand a few factors can be presented which tend to lend support to this estimate of $350,000,000. In the first place, Mississippi in 1940 had a per capita income only 15 percent less than Puerto Rico’s estimated amount for 1941–42, and its average value of land and buildings per farm acre was $24.80 in 1940 compared with $92 for Puerto Rico.65 Second, it is definitely known that government in Puerto Rico produced at least $140,000,000 in 1941–42, or more than Puerto Rico’s alleged total income of $126,100,000 as reported by a private agency for only four years previously.66 Third, net Insular and municipal revenues, excluding all Federal receipts, were $67,000,000 in 1942. If this last constitutes a tax of 25 percent of the Island’s insularly derived income (which in view of its not having to pay Federal taxes is very low), the insularly produced income would be $268,000,000, to which $78,000,000 of Federal expenditures must be added, the total income for the Island would then become $346,000,000 or very close to the figure derived above by an entirely different method and obtained by the Chamber of Commerce through a third method.

Whatever the total income may be, it is clear that the great majority of Puerto Rican families actually receive less than such an income of $1,000. A survey of 2,000 wage earners’ families taken between March and November 1941, indeed, indicated that the “estimated annual earnings per family” were $341.67 The survey estimated that 300,000, or 85 percent of Puerto Rico’s 350,000 families, were in an income class similar to that covered by the sample survey. It is interesting to note that this checks with Census data indicating that 83 percent of all owner-occupied units in Puerto Rico rent for under $10 and that 83 percent of all owner-occupied units are valued at under $300.

Certainly families in such housing could not be earning, on the average, more than this $341 a year. Therefore, on the basis of the WPA survey, the total received by these 300,000 wage-earning families in 1941–42 was $102,000,000, leaving $248,000,000 to be received by the remaining 15 percent of families in Puerto Rico or $4,960 per family. But there is probably a further concentration of wealth in this second group. If the Chamber of Commerce estimate for this concentration is used, 10,000 of the 50,000 families received an average income in 1941–42 of $9,600.68 Table 25 summarizes these calculations.

<table>
<thead>
<tr>
<th>Number of families</th>
<th>Total income</th>
<th>Average family income</th>
</tr>
</thead>
<tbody>
<tr>
<td>300,000</td>
<td>$102,000,000</td>
<td>$341</td>
</tr>
<tr>
<td>40,000</td>
<td>152,000,000</td>
<td>3,800</td>
</tr>
<tr>
<td>10,000</td>
<td>96,000,000</td>
<td>9,600</td>
</tr>
<tr>
<td>50,000</td>
<td>300,000,000</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

Obviously such a distribution does not conform to the following facts: (1) that only 2,171 owner-occupied dwelling units were valued at over $5,000 in 1940, (2) that only 1,870 tenant-occupied dwelling units rented for over $50 a month, (3) that there were only 17,527 private automobiles registered in Puerto Rico in 1942; (4) that there were only 8,474 residential telephone stations in service during 1940–41; (5) that only 10,132 nonexempt income tax returns were filed for 1942. In short it would appear that the distribution of income is more concentrated than these figures indicate or that the total income is much less than that estimated both in this plan or by the Puerto Rico Chamber of Commerce.

The very magnitude of the possible error in the distribution figures will, it is hoped, challenge other agencies and individuals to give them special consideration. For, if either the total income or its distribution estimates are approximately true, the figures here presented for the first time are obviously of great significance.

65 However, the total value of farm land and buildings in Mississippi (1940 population 2,163,796) was $474,986,000 in comparison with $719,868,000 for Puerto Rico. The latter is extremely low if the gross value of Puerto Rico’s agricultural production is really in the neighborhood of $110,000,000.


67 Survey of Income and Expenditures of Wage Earners in Puerto Rico, Work Projects Administration, San Juan, P. R., 1943.

68 Holiday, op. cit.: "The income of the 10,000 persons (families) whom we may call our patrons was $102,000,000 in 1942. The difference [from his estimated total income] of $248,000,000 was the income of the other 9,010,000 persons concerned [or 40,000 families]." The figure of $9,600 in Table 25 is obtained by using Mr. Holiday’s ratio of income distribution applied to our estimate of total income; i.e., 10,000 families receive 27.4 percent of his estimated total income of $350,000,000.