Appraisal of Nutrition in Haiti

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THIS study was organized in order to provide a background of information necessary to advise the Haitian Department of Public Health in instituting an effective nutrition program. It also afforded an opportunity to study the problems of conducting a comprehensive field nutritional survey and to extend and adapt to a civilian population the nutritional survey methods (*Manual for Nutrition Surveys*, May 1957, U.S. Government Printing Office, Washington, D.C.) developed by the Interdepartmental Committee on Nutrition for National Defense (ICNND).

Haiti seemed a desirable location for such a study since the findings should be not only of international scientific interest, but also the observations and practical recommendations could be used by the Haitian government to formulate programs for improvement of the nutritional status of their people.

Haiti consists of a coastal plain, a central plateau and several fertile valleys between rugged mountains of from about 5,000 to 9,000 feet elevation. The country is made up of five districts. The coastal plain is more important agriculturally in the northwest and northern districts. The central plateau is contained in the Artibonite district The Cul de Sac and the largest city, (225,000) Port-au-Prince, are in the western district, and the coastal plain and valleys are in the isolated southern peninsula.

The study was designed to sample as many of the various Haitian environments as possible. Therefore, the nutritional study covered the people of the coastal plain in the villages of Limbe, Limonade, Trou du Nord in the northern district. The people of the Artibonite valley were studied in the villages of Mirebalais, Deschapelles, and Pont de l'Estere; those of the Cul de Sac in the villages of Croix des Bouquets and Carrefour, and of the mountainous areas in St. Raphael in the north, Gros Morne in the northwest and Furcy in the south. The urban population was sampled in the three principal cities of Port-au-Prince, Cap Haitien and Gonaives. The towns of La Boule, Petionville and Kenscoff are hillside suburban areas near Port-au-Prince. They represent a relatively well-to-do population group.

In the time available it was not possible to visit the southwestern cities of Cayes, Jacmel and Jeremie. No information was obtained from the rather isolated southern peninsula because of transportation difficulties during the rainy season in which the survey was conducted.

The survey included 3,113 detailed physical examinations, and analyses of 454 specimens of blood and urine. These procedures were essentially as described in the Manual of the ICNND. The number examined in the various locations is given in Table I. Dietary histories were taken from 163 families and detailed observations made on farm crops, food on sale in markets, and food processing

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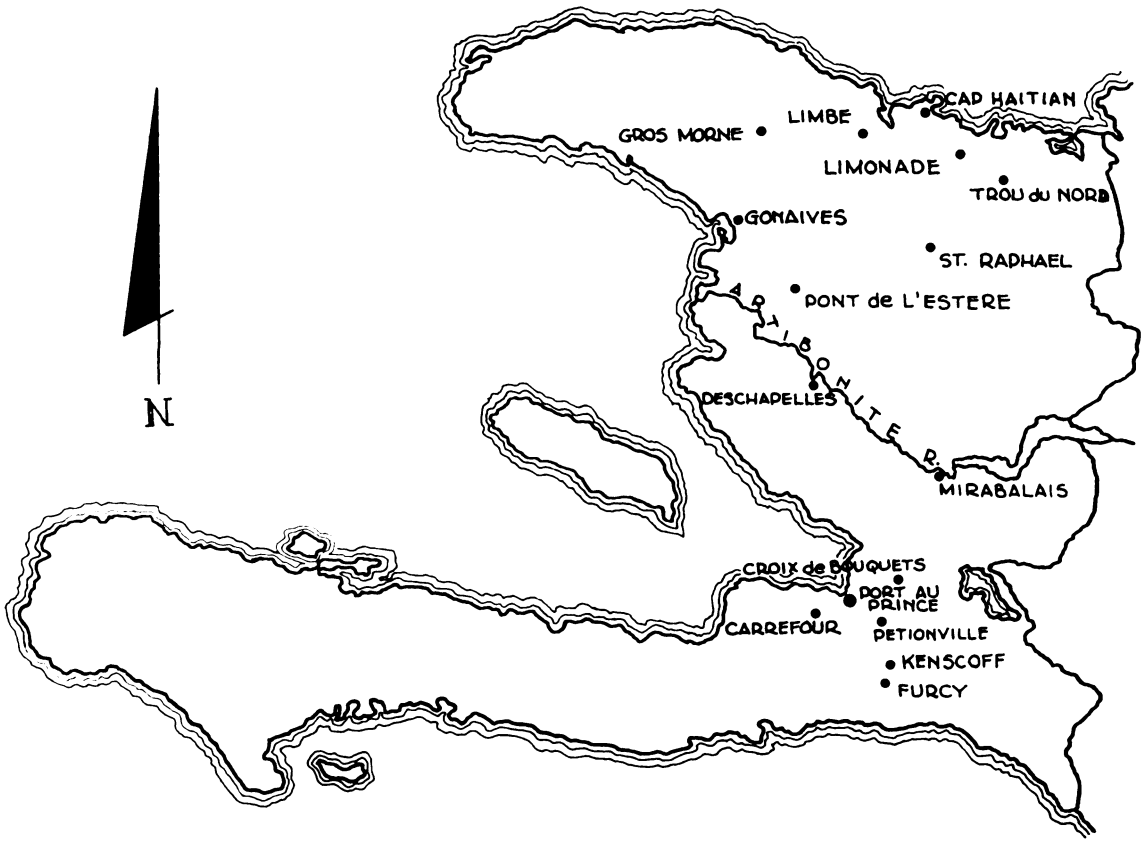

Map of Haiti

plants. The findings are discussed in the appropriate sections of this report. The field work was carried out during the month of June 1958.

FOOD AND AGRICULTURE IN HAITI*

The agricultural situation in Haiti was reviewed in some detail by a United Nations Mission (Mission to Haiti, Report of the United Nations Mission of Technical Assistance to the Republic of Haiti, Lake Success, New York, 1949) and by M. A. Holly ("Agriculture in Haiti," Vantage Press, Inc., New York, 1955). Attention is also directed to "Making a Living in the Marbial Valley," by Alfred Metraux, Unesco, 19 Avenue Kleber, Paris, December 7, 1951, Unesco/ED/occ/10. In the five to ten years since these reports were prepared, the economy of Haiti has suffered setbacks due to the destructive hurricane, Hazel, in 1954, and to a continuing decline in the production of cotton because of the damage caused by the boll weevil, and in bananas as a result of Panama disease and Sigatoka. However, the completion of the dam across the Artibonite river at Peligre and the accompanying potential increase in irrigated land of the Artibonite valley offer promise for future expansion.

An outline of Haitian agriculture and food problems is not complete without the following basic information: Haiti is mountainous. The total area is 10,700 square miles or 2,775,000 hectares, of which approximately one-fifth is arable plain and one-seventh arable mountainous area. The rest by virtue of topography, rainfall, soil composition, etc. is not available for farming. In the plains area 200,000 hectares of the potential 500,000 are now used. An accurate estimate of the mountain area farmed is not available.

* The sections on Food and Agriculture, Food Technology and Vital Statistics were prepared by H. S. Olcott and G. Nicolas.

TABLE I
Location of the 3,113 Persons Examined

Location	No. Persons Examined	Institution	Characterization
I	23	Public Health Dispensary, La Saline, Port-au-Prince	Slum area
	53	Primary School, La Saline, Port-au-Prince	Slum area
	75	Public Health Dispensary, Carrefour	Poor suburb
II	73	Public Health Dispensary, Petionville	Suburbs of good economic status
	77	Public Health Dispensary, Kenscoff	
	147	Public Health Dispensary, La Boule*	
III	106	Public Health Dispensary, Mirebalais	Rural towns, valley and farming
	123	Public Health Dispensary, Croix des Bouquets*	
	132	Public Health Dispensary, Pont de l'Estere	
IV	132	Public Health Dispensary, Furcy	Rural, southern mountains
V	103	Public Health Dispensary, Gros Morne	Rural towns, northern mountains
	126	Public Health Dispensary, St. Raphael	
VI	143	Public Health Dispensary, Gonaives*	Urban, sea level
	166	Public Health Dispensary, Cap Haitien	
VII	111	Public Health Dispensary, Limbe*	Rural towns, north coastal plain
	159	Public Health Dispensary, Limonade*	
	84	Public Health Dispensary, Trou du Nord	
VIII	93	Public hospital, Cap Haitien	Urban, ambulatory patients
	96	Public hospital, Port-au-Prince	
IX	325	Albert Schweitzer Hospital, Deschapelles	Rural
X	25	Orphanage, mixed, Port-au-Prince	Public
	74	Orphanage, girls, Port-au-Prince	Parochial
XI	177	Guilloux boys school, Port-au-Prince	Parochial
	134	Guilloux boys school, Petionville	Parochial
	71	Guilloux boys school, Carrefour	Public
XII	204	Venezuela girls school, Port-au-Prince	Parochial
	81	Venezuela girls school, Kenscoff	Parochial

* In these institutions groups of school children were included with the patients attending the dispensaries for therapy.

Although these figures suggest that ample area exists for the expansion of farm land, there are great practical difficulties. The richest, most accessible areas are already densely populated. Lack of irrigation, lack of roads, irregular distribution of rainfall, and lack of proper soil types for known crops all contribute to the present disuse of some of the areas that could be cultivated.

Population pressure is high. The density is

350 to 400 per square mile of total area, or 1,100 to 1,200 per square mile of tillable area. This amounts to one-half acre (one-fifth hectare) for each individual, an extremely low value in comparison with those of most countries.

From 85 to 90 per cent of the population live on individual farms or in clusters of homes (mostly thatched-roofed huts) with less than fifty to one hundred individuals. The nature of this distribution may be illustrated by the following 1950 census estimates:

Area	Population
Cap-Haitien	30,000
Cap-Haitien surrounding country	150,000
Gonaives	18,000
Gonaives surrounding country	200,000
Jeremie	14,000
Jeremie surrounding country	220,000
Hinche	5,500
Hinche surrounding country	125,000

With the exception of a few large towns, the illiteracy rate is about 90 per cent. School facilities are available for approximately 20 per cent of the children between the ages of five and fourteen, but pupil attendance is irregular because of the distances involved, lack of transport, illness and the pressure of chores. Transportation between the various areas of Haiti is rendered difficult by the lack of good roads. During the rainy seasons some roads are rendered impassable by flooding streams. Most produce is carried to local markets in baskets on the heads of peasant women or in paniers on donkeys.

The majority of Haitians are illiterate farm families dependent for food on what they grow on their limited patches of land or on what they can purchase at local markets for the small amount of money they make by selling produce. It was estimated in 1949 (U.N. Mission) that the annual per capita income may be as low as $25, but a peasant family handles considerably less money than this. The legal minimum daily wage is Gdes. 3.50 (70¢; the gourde is stable at 20¢), but only a small portion of the population is employed.

Land holding problems are of the greatest seriousness. Whereas a few city and country residents own substantial amounts of land, the average peasant holds less than one-half of a carreaux (1 carreaux = 3.16 acres = 1.29 hectares). The Artibonite valley with 33,000 hectares of cultivatable land has a population of approximately 33,000 farm families, some of which have substantial holdings (up to 400 hectares). The remainder obviously have much less. Thus the peasant in many parts of the country is forced to grow multiple crops for family use with consequent low yields of each. Plantain, corn, congo peas, sweet potatoes, a mango tree and coffee trees may all be found on the same acreage. Under these conditions it is extremely difficult to estimate the acreage devoted to a single crop or to determine the total yield. An attempt to obtain this information was made during the 1950 census and although the data may be greatly in error, they are the best that can be obtained. A résumé appears in Tables II and III.

The foods available to the Haitian peasant are listed in Table IV. Within each category the foods have been placed in the approximate order of their importance in the Haitian diet, based in part on food production data, on observations in the market place, and on discussions with Haitians acquainted with the food habits of the rural population.

Corn and millet are the cereal mainstays. The diet is fortified with respect to calories by the starchy roots (sweet potato, yautia, yam and cassava), and by sugar, rice and plantain. Vegetable protein is furnished mainly by beans and nuts. The amount of high protein foods ingested is small and difficult to estimate.

The census of 1950 included an enumeration of livestock. Specialists in animal husbandry at the Department of Agriculture provided estimates of the changes which might have occurred since. Table V represents a rough approximation of present farm animal popu-

TABLE II

Principal Food Crops of Haiti (Area Under Cultivation)*

Crop	Area in Hectares	% of Area in Each Department				
		North	Northwest	Artibonite	West	South
Corn	310,000	11	3	34	31	21
Millet†	240,000	2	3	34	41	18
Coffee	145,000	15	7	4	28	46
Plantain	130,000	13	5	16	41	25
Sweet potato	105,000	13	11	16	29	31
Beans	97,000	21	7	27	28	17
Sugar cane	77,000	12	5	26	32	25
Rice‡	63,000	20	3	47	12	18
Banana§	48,000	34	25	36	..	5
Peanut	13,000	22	11	20	13	35
Cacao	9,000	15	7	4	28	46

* 1950 census. Subject to the errors discussed in the text. In addition, these areas probably represent the situation during the month of August. Since, in most parts of Haiti, two and sometimes three different crops are grown on the same area within one year's time, the figures shown may have little significance for different times of the year. The data for more or less permanent crops, such as coffee, cacao, plantain and cane, are probably of greater significance than the rest. Data for the Department of the South have not yet been published. We are indebted to Mr. O. Boigris, Institut Haitien de Statistique, for permitting us to see proof sheets.

† Millet and sorghum are not differentiated. Locally both are called "petit mil."

‡ In 1958, a good crop year, the yield of rice may reach 110,000,000 pounds.

§ The decline in banana production since 1950 makes these data obsolete. Exports of bananas amounted to 7,300,000 "stems" in 1946–1947. By 1950–1951 they had fallen to 1,340,000 stems. Figures for 1953–1954, 1954–1955, 1955–1956 are as follows: 393,000; 49,000; 164,000, respectively.

lation without, however, furnishing any information with respect to turnover rate.

No information is available concerning the production of milk or eggs. Goat milk is sometimes consumed in Haiti, chiefly by tuberculous patients.

In contrast to the lack of over-all data on the consumption of meat, milk or eggs, the amount of fish consumed in Haiti can be calculated with some degree of accuracy. From 13,000,000 to 19,000,000 pounds of smoked herring, dried cod fish and assorted salted fish are imported annually (Table VI). In addition, about 4,000,000 pounds of marine food products (fish, crab, etc.) are landed by Haitian fisherman each year. A program designed to introduce pond culture of fish in Haiti has not yet been successful. However, the introduction of the rapidly growing tilapia into Haitian rivers has succeeded and a considerable but unknown amount of additional fish is being caught by the Haitians. The amount of such fish used may be as large as 1,000,000 pounds annually, but it is probably much less. Thus the total annual consumption is probably the equivalent of between 20 and 25 million pounds of fresh fish, or 5 to 6 pounds per capita.

The marine fisheries of Haiti have never been adequately developed. An FAO survey has indicated that large quantities of bonito are available in Haitian waters (Report to the Government of Haiti and Maritime Fish in Haiti, FAO Report No. 721, Rome, August, 1958).

Comment on Individual Crops

Haitian coffee has a ready sale in the world market. It is extremely important to the economy as the largest single source of income. Yield and quality have suffered because of the peasants' lack of knowledge concerning care of the trees and the crop. Efforts are being made to increase the dissemination and use of such information. Since the Haitian coffee tree will grow and produce only in shade, any

TABLE III

Principal Food Crops of Haiti (Yields and Distribution)*

Crop	Pounds (in millions)	% of Area in Each Department				
		North	Northwest	Artibonite	West	South
Corn	471	5	5	32	35	23
Millet	383	1	1	44	28	26
Cassava	229	21	7	10	14	48
Sugar cane†	190	..	..	..	..	..
Sweet potato	175	11	9	25	27	28
Plantain	101	12	8	20	38	22
Rice	92	6	1	72	9	11
Beans	75	11	2	30	39	18
Coffee	63	4	7	3	41	45
Yam	41	9	17	4	16	54
Yautia	29	9	6	6	10	69
Peanut	5	13	3	23	21	40
Cacao	4	12	3	3	2	80
Distribution of population	..	17	5	19	35	24

* Cf. footnotes to Table II.

† In terms of sugar. For rough approximation, 1 ton of cane yields 200 pounds of sugar. The census data for yields in the various departments are not internally consistent and have therefore been omitted.

increase in production requires that shade trees be planted first.

Corn is grown in all parts of Haiti and on almost every square foot of plantable land including the sides of drainage ditches and steep and stony hillsides. Yields per acre are therefore extremely poor. Even on good land agricultural practices are wasteful, and information on better agricultural practices already available is not used. Thus fields may be and are extensively damaged by insect infestation, which the application of a few cents worth of insecticide could have prevented. Often, the peasant has neither the few cents nor the knowledge that this could be done. Yields could also be tremendously increased by irrigation wherever this is possible, by the use of new varieties of seed, and by the adoption of the already developed practices used in more advanced agricultural regions.

Millet and sorghum are more resistant to drought than corn and can be grown in areas where corn will not produce a comparable yield. Millet Chandelle, grown almost exclusively in the Gonaives area, is reputed to have exceptional nutritional properties. Analyses of samples are being carried out in connection with this survey.

Rice is a favorite cereal in the Haitian diet, but it is more expensive than corn or millet. In the irrigated areas, seed imported from the southern United States is found to give the best yields. A "mountain" rice is grown in areas of higher elevation which have adequate rainfall. The development of irrigation projects in the Artibonite valley is continually bringing more land into effective rice production. However, this area (approximately 10,000 hectares), still remains smaller than that which was devoted to rice culture before flood control and drainage projects were started. Thus several thousands of hectares were rendered infertile. After an interval of several years the development of canal facilities for irrigation will return the land to agricultural use.

An invasion by rats during the 1957 crop year was responsible for the loss of tremendous quantities of rice—perhaps as much as 10,000,000 pounds in the Artibonite valley alone. Pesticides, such as warfarin and zinc phosphite, were successfully used to kill over

TABLE IV

Food Crops of Haiti*

English Name	Haitian Name	Latin Name	Approximate Annual per Capita Consumption† (lb.)
Cereals:			
Corn	Mais	*Zea mays*	120
Millet	Petit mil (chandelle)	*Pennisetum typhoideum*	95
Sorghum	Petit mil (gros)	*Sorghum vulgare*	
Rice	Riz	*Oryza sativa*	23
Wheat flour	Farine de blé	*Triticum aestivum*	20
Starches:			
Plantain	Banane	*Musa paradisiaca*	240
Cassava‡	Manioc	*Manihot utilissima*	56
Sweet potato	Patate	*Ipomoea batatas*	44
Yam§	Igname	*Dioscorea alata*	10
Breadfruit	Arbre véritable	*Artocarpus incisa*	. .
Breadfruit‖	Arbre pain	*Artocarpus incisa*	. .
Yautia	Malanga	*Xanthosoma terviride*	7
Potato	Pomme de terre	*Solanum tuberosum*	. .
Dry legumes, nuts:			
Dry beans¶	Pois rouge	*Phaseolus vulgaris*	10
Pigeon peas	Pois congo	*Cajanus indicus*	. .
Peanuts	Pistache	*Arachis hypogaea*	. .
Blackeye peas	Pois inconnu	*Vigna sinensis*	. .
Lima beans	Pois de souche	*Phaseolus lunatus*	. .
Coconuts	Coco	*Cocos nucifera*	. .
Cashew	Noix d'acajou	*Anacardium occidentale*	. .
Fresh vegetables:**			
Pumpkin	Giraumon	*Cucurbita pepe*	. .
Chayote fruit	Mirliton	*Sechium edule*	. .
Squash	Courge	*Cucurbita sp.*	. .
Cabbage	Chou	*Brassica oleracea*	. .
Green leaves††	. . .	. . .	. .
Tomato	Tomate	*Lycopercicum esculentum*	. .
Egg plant	Aubergine	*Solanum melongena*	. .
Green beans	Haricots verts	*Phaseolus vulgaris*	. .
Okra	Calalou	*Hibiscus esculentus*	. .
Shallot	Échalote	*Allium ascalonicum*	. .
Peas	Petis pois	*Pisum sativum*	. .
Chives	Cive	*Allium schoenoprasum*	. .
Fruits:§§			
Mango	Mango	*Mangifera indica*	. .
Banana	Figue banane	*Musa sapientum*	. .
Orange‖‖	Orange	*Citrus sinensis*	. .
Avocado	Avocat	*Persea americana*	. .
Grapefruit	Chadeque	*Citrus grandis*	. .
Melon¶¶	Melon	*Cucumis melo*	. .
Mamey	Abricot	*Mammea americana*	. .
Pineapple	Ananas	*Ananas sativus*	. .
Soursop	Corossol	*Annona muricata*	. .
Granadilla	Grenadine	*Passiflora quandrangularis*	. .
Guava	Goyave	*Psidium guajava*	. .
Caimito	Caimite	*Chrysophyllum caimite*	. .

See footnote on opposite page.

TABLE V

Number and Distribution of Livestock in Haiti (Based on 1950 Census*)

Livestock	No.	% of Total by Departments				
		North	Northwest	Artibonite	West	South
Cattle	640,000	18	4	19	29	30
Pigs	1,250,000	15	4	24	31	26
Poultry†	4,400,000	17	3	25	27	28
Goats	850,000	13	7	23	28	29
Sheep	60,000	15	17	20	10	38

* Subject to the errors mentioned in the text (see footnote to Table II). The estimates for number of cattle and pigs are 10 per cent greater and for poultry 15 per cent greater than the 1950 data.

† Chickens, includes 1 per cent or less of turkeys. Ducks and geese are rare.

500,000 rats. The extermination program is continuing. Birds are responsible for a noteworthy loss of rice and millet, possibly to the extent of 10 to 20 per cent in some areas. No effective means for their control are known.

The sweet potato (patate), yautia (malanga) and yam (igname) are high-yielding crops which furnish a large proportion of the calories in the Haitian diet. They are most often grown together with corn or plantain. Yields are relatively large. Possibly as much as 20 per cent of the sweet potato crop is lost by rot or nematode or insect infestation.

Many fresh vegetables can be grown in Haiti if and when proper demand and mar-

TABLE VI

Imports of Fish into Haiti*

Year	Pounds
1951–1952	18,200,000
1952–1953	14,400,000
1953–1954	18,900,000
1954–1955	13,300,000
1955–1956	15,200,000

* Valued at between $1,200,000 and $1,750,000. In 1955–1956, the relative amounts of various products were as follows: dried cod, 14 per cent; smoked herring, 40 per cent; salted herring, 42 per cent; others, 4 per cent. More than 95 per cent is obtained from Canada.

* In each category the crops are listed in an approximate order of importance with regard to per capita consumption.

† Based on census estimates of crop production and on imports.

‡ Two kinds of manioc are grown, manioc amer (bitter) and manioc doux (sweet). The latter (*Manihot cassava*) is a smaller root and the skin is lighter. It accounts for about 10 per cent of the manioc production.

§ The Haitian yam is a large, irregularly shaped root. A separate smaller variety (*Dioscorea occidentalis*) is "Igname siguine."

‖ "Arbre pain" contains 25 to 50 nuts which are usually the only part eaten. It is less important than "arbre veritable."

¶ Several additional varieties of *Phaseolus vulgaris* are available; e.g., "pois blanc," "pois noir," "pois navet."

** The following vegetables are also grown, mostly for the city market: carrot (carotte, *Daucus carota*), beet (betlerave, *Beta vulgaris*), cucumber (cocombre, *Cucurbita sativus*), onion (oignon, *Allium cepa*), turnip (navet, *Brassica rapa*).

†† A number of different leaves are used. The more common bear the following local names: cresson (watercress, *Rorippa nasturium aquaticum*), Lanman, epinard, caya, pourpier, panzou. The leaves of the bean, chayote, pumpkin and caraibe are also offered in local markets.

§§ The following fruits are also available in season but in smaller quantities: lime (citron, *Citrus aurantifolia*), papaya (papaye, *Carica papaya*), peach (pëche, *Prunus persica*), sapodilla (sapotille, *Achras sapota*), cashew (pommes cajou, *Anacardium occidentale*), pomegranate (grenade, *Punica granatum*), sweetsop, custardapple (cashiman, *Annona squamosa*, *A. recticulata*), quenepe. With the exception of sweet oranges, grapefruit, bananas and pineapple, the fruits of Haiti grow wild.

‖‖ The sour orange (orange sure, *Citrus aurantium*) is also widely available. The juice is used for washing meat, yam, etc.

¶¶ Includes the watermelon (melon d'eau, *Citrullus vulgaris*).

keting systems can be developed. Those available at present in the smaller markets are limited for the most part to eggplant, okra, green beans and the native tomato; nevertheless, tomatoes, onions, beets, potatoes and carrots have recently become available in the Port-au-Prince marketing area. These are considered cash and not subsistence crops. Similarly, certain areas of Haiti could be used for the production of orchard fruits, such as the peach, plum and grape, if markets were developed. The U.N. Mission recommended the introduction of the mangosteen, Japanese persimmon and pomelo. The mango is the most abundant fruit of Haiti. During the four- to five-month season, the Haitians probably consume at least 2,000,000,000 mangoes. A considerable but unknown number are eaten by pigs or rot on the ground.

Preservation, Transportation and Marketing

The perishable crops of Haiti are marketed as soon as they are harvested. Cereal grains are first dried, if necessary, by exposing them to the sun on cement slabs or on pounded earth. Excess grain is stored in cleaned 55 gallon oil drums, in shallow cement wells or in thatched huts built on tall stilts supplied with devices to prevent access to rats. Dried corn is often stored on the husk-protected cob, in bundles of several hundred cobs, suspended by wires or ropes from the branches of trees.

The crops are taken to market in baskets carried by the women on their heads, or on the backs of donkeys. Transportation over longer distances is effected by autobuses which carry passengers and produce together or, less often, by truck. The railroad lines in Haiti are operated by sugar and sisal companies, and are used principally to carry sugar cane, sugar produce and sisal in the Port-au-Prince and Cap-Haitien areas. Total trackage is less than 200 miles.

All trading of food crops is done in local markets held usually one or two days each week. Port-au-Prince and the larger towns have provided covered pavilions for the purpose, but on busy days market activity expands into the surrounding streets. In the villages trading is out-of-doors. Buying and selling is carried on from small stocks placed directly on the floor or ground, or in woven baskets or dishes. Sometimes coffee and sugar are sold by weight, but usually foods are sold by the piece or from cans or cups of various non-standardized sizes. For export crops, such as coffee, cacao and cotton, brokers buy small odd lots from the individual, then forward their combined purchases to the port cities. Similarly for the distribution of imported products, brokers sell relatively larger amounts to market women who, for example, cut up the fish into pieces which can be sold for a few cents or who melt the 5 pound can of lard and dispense it in amounts as small as a fraction of an ounce.

However inefficient the market day system may be, it provides a social outlet for the peasant women who are otherwise almost completely isolated from human contacts outside their own families.

FOOD TECHNOLOGY

Commercial food processing in Haiti is limited to the following: manufacture of sugar products from cane, expression of cottonseed oil and refining and blending of this and of imported edible oils, the manufacture of rum and other alcoholic drinks (clairin, tafia), and coffee drying and decortication. A large modern flour mill was scheduled to begin operation in 1958. Small scale operations include the grinding of corn, essential manufacture of oil and milling. Bakeries and soft drink bottling plants operate in the large cities. There is no canning, freezing, dehydrating or pickling.

The Haitian-American Sugar Company (HASCO), Port-au-Prince, has a capacity for producing up to 75,000 tons of sugar annually. Production varies depending upon the availability of cane. About 40,000 tons are consumed in Haiti. Surpluses are exported. Thus in 1955-1956, 36,000 tons of crude sugar were exported, 32 per cent to Japan, 25 per cent to the United Kingdom, and the rest to the United States, Belgium and Korea. Molasses is disposed of by export. Products of this company for Haitian use are distributed as refined sugar (about 22 per cent), and the rest as "sucre populaire," about 97 per cent sucrose

The two sell for about 8 and 6 cents per pound, respectively. Small sugar processors operate at Cap-Haitien and Cayes. The production of these plants is estimated at 1,500 to 3,000 tons annually, although the capacity of the latter is 20,000 to 30,000 tons. Lack of available cane and the low sugar content of the local crop, as well as mechanical difficulties, account for the small output of the Cayes mill.

On the basis of estimates that the mills absorb only about one-half of the cane grown in Haiti, that most of the rest is crushed to juice and that half of this is used to make sugar products ("sirop" and "rapadou"), it may be calculated that the annual per capita consumption of sugar from cane is 30 to 40 pounds. This is considerably less than the 100 and more pounds of sugar consumed in more highly developed countries. The cane juice not evaporated for syrup products is used in the manufacture of the alcoholic drinks: rum, clairin and tafia.

The two companies which divide about equally the manufacture of cottonseed oil are Huilerie Nationale, S.A. and S.A. Usine a Manteque de Port-au-Prince, both in Port-au-Prince. These companies are equipped with conventional gins, cookers and presses, and operate at or near capacity when cotton production is high. However, cotton production has been declining gradually during the past twenty years, in part due to the encroachment of the boll weevil, and in part due to lack of the grower's incentive to take care of or reap his crop. The local cotton plant is a perennial (Gossypium barbadense). Production of cotton seed has fallen from about 14,000 tons to about 3,500 tons annually. The Haitian requirements for edible oils are met by the importation of lard, soybean oil and smaller amounts of other oils. In 1955–1956, 3,600 tons of lard and 1,100 tons of soybean oil were received. Together with an estimated production of 500 to 1,000 tons of local cottonseed oils, the total amount of available processed fats and oil amounts to 5,000 to 6,000 tons. Thus the average per capita consumption of processed oils and fats is about 2.5 to 3 pounds annually.

The Haitian processors refine both their own cottonseed oil and the imported soybean oil. The imported hardened fat is used for the manufacture of a blended vegetable fat compound. There are no facilities for hydrogenation of oils or solvent extraction of cottonseed cake. The latter is largely exported; one-third is said to be used in Haiti as cattle feed or manure.

Coffee is the most important single source of revenue (65 to 80 per cent of the value of total exports). About one-fifth of the crop is used locally and the rest, amounting in 1955–1956 to about 34,000 tons (valued at $33,400,000), is exported. Drying and decortication are carried out by all technics from the most primitive to that using the best modern equipment. There are no large plants but a number of coffee dryers and decorticators are scattered throughout the country.

The wheat flour mill (Caribbean Mills Co., Port-au-Prince), which began operations in 1958, can provide for the entire requirements of Haiti. Wheat was grown only in three small projects in 1955 on the island, although bread and other wheat products are popular foods. This need has hitherto been met by importing wheat flour. In 1956–1957 this amounted to 37,000 tons (approximately 20 pounds per capita annual consumption). With the mill in operation, wheat as such will be imported (from Canada and the United States). The mill is designed to produce 350,000 pounds of high protein flour daily. If it operates 300 days a year at this capacity, it will produce 52,000 tons of flour or an amount approximately one-third more than Haiti can absorb. It is planned to export this surplus to surrounding Caribbean islands. The daily yield of 35 tons each of shorts and bran will be exported unless markets can be developed locally. No consideration has yet been given to an enrichment program for the flour.

A small clean rice milling plant is run by the ODVA (Organisme de Developpement de la Vallee de l'Artibonite) in the Artibonite valley as a service to the rice growers of the area but, in general, rice is milled at home in large wooden mortars, or is taken to one-room mills in the villages. Most of such equipment is of Hamburg origin. Rice is often parboiled at

home by heating a large drum containing a small amount of water and filled with rice (50 pounds). After the rice is thoroughly steamed, it is spread on cement slabs to dry. The hardened kernels are valued because the yield during milling is greater. Increases of as much as twenty per cent are realized. There is no recognition by the Haitians of the known nutritional benefits of parboiling.

Corn grinding equipment is similarly small and widely scattered. The peasants themselves sift the ground corn so that both flour and coarse meal of many grades are offered in the markets.

One large and ten or twelve small essential oil plants are scattered throughout the country. The oils manufactured are amyris, vetiver, lemon-grass, lime and others. Total exports in 1955–1956 amounted to 260,000 pounds.

A large modern distillery and a number of primitive stills produce the alcoholic requirements. Yeast fermentation of concentrated cane juice or diluted cane molasses provides the raw material for these stills. The amounts of rum, clairin and tafia consumed are not known. If the equivalent of 20,000 tons of sugar is fermented, it may be estimated that 10,000 tons of alcohol are produced or the annual per capita consumption is roughly 5 pounds of alcohol (1 to 2 gallons of rum). This figure may be greatly in error.

Some years ago an American company investigated the possibility of establishing a pineapple canning industry in the Cap-Haitien area. It was found feasible to produce suitable pineapple on plantations and a plant was erected. However, before production began the economic situation changed and the project was abandoned.

Salt is manufactured in Haiti in the Gonaives and Port-au-Prince areas by solar evaporation of sea water in dirt basins. When sufficient crystals have formed on the sides and bottoms and on branches, which are used to increase the surface for crystallization, the salt is harvested by hand. The branches are stripped into wicker baskets, the crude salt is washed with the mother liquor and dried in piles in the sun. This grayish large crystal salt comprises most of the salt marketed in Haiti. According to M. Routh, FAO Fisheries Specialist, the impurities render it unsuitable for salting fish. Any increase in fish-salting activity would require either the introduction of technics for purifying salt or the importation of salt of high purity.

SECTION OF VITAL STATISTICS

There exists no reliable statistical information on the number of people, births, deaths, causes of deaths, etc. in Haiti. The only census ever made was obtained during a twelve-hour period on a Sunday in August 1950 (total reported population 3,111,689). This figure is admittedly only a rough approximation. Complete records on births and deaths have never been obtained. The following figures are therefore only studied guesses: Total population, 3,800,000 ± 400,000; births, 180,000 ± 20,000 (45 per 1,000); deaths, 85,000 ± 15,000 (25 per 1,000). Infant mortality (deaths of children below the age of one) is high. The practice of burying dead infants without registration or funeral is admittedly widespread. An estimated infant mortality of 200 to 250 per 1,000 live births therefore may be low. Of those who survive to one year of age, 200 to 250 more die within the next four years. These approximations lead to the conclusion that only one child of two born alive survives to the age of five years.

It has been suggested (C. Bengoa, personal communication) that the ratio of deaths of children below five years of age to total deaths may be useful as an index of nutritional and health standards in a population. Such ratios are fairly easy to approximate since they do not depend on having a complete record of deaths. In Table VII are listed total registered deaths and percentage of deaths of children below five years of age for several communities in Haiti for two separate years. The over-all ratio of 47 per cent may be considered to be an absolute minimum in view of the practice, already mentioned, of not recording infant deaths. This figure may be compared with those reported for Egypt, 59 per cent (1952), Costa Rica, 55 per cent (1954), and the Dominican Republic, 53 per cent (1953),

TABLE VII

Comparison of Deaths of Children Below the Age of Five to Total Recorded Deaths in Selected Communities of Haiti (1955 and 1956)*

Community	Year	No. Recorded Deaths	No. Deaths of Children Below Five	Per Cent
Port-au-Prince	1955	2,110	982	47
	1956	2,872	1,570	54
Cap-Haitien	1955	248	94	38
	1956	202	61	30
Saint Raphael	1955	353	171	48
	1956	364	168	46
Limbé	1955	266	91	34
	1956	308	106	34
Limonade	1955	235	68	29
	1956	275	86	31
Total		7,233	3,397	47

* The data for Port-au-Prince were obtained from the Bulletin Trimestriel de Statistique, No. 25, June 1957. Those for the other cities were obtained from the original death registers in the Office de l'Etat Civil, Cap-Haitien.

TABLE VIII

Causes of Death (1950 and 1951)

Causes	% of Total Deaths	
	1950 (1,905)	1951 (1,825)
Non-specific or poorly defined	10.6	...
Tuberculosis	6.7	9.3
Nephritis	4.9	2.7
Diarrhea and enteritis (in children under two years of age)	4.6	...
Infection during childbirth	4.6	...
Malaria	4.1	5.8
Premature birth (not including stillborn)	3.7	...
Tetanus	2.9	6.2
Meningitis	2.5	2.4
Sudden death	2.4	...
Debility	...	4.8
Functional stomach difficulty	...	4.4
Gastroenteritis	...	4.3
Helminthiasis	...	2.3
Cerebral hemorrhage	...	2.2
All other causes	53.0	55.6
In children below five years of age	...	43.0

NOTE: Figures in parentheses represent total number of deaths.

countries having similar difficult problems of economics, health, nutrition and statistics; and contrasted with statistics from Japan, 18 per cent (1953), Uruguay, 12 per cent (1954), United States, 8 per cent (1953), and England, 4 per cent (1953), for countries which have overcome some of these difficulties.

The data presently available on causes of death cover only those which occurred in hospitals. In the most recent report (Rapport Annuel Bio-Statistique du Service de la Sante Publique, 1951; Imprimerie de l'Etat, Port-au-Prince, 1958) the causes of deaths are tabulated for 1,825 persons during 1951 and for 1,905 persons during 1950. Since these represent only 2 to 3 per cent of the total deaths, and are a partially selected population (those who get to hospitals), the causes of deaths can have only qualitative significance. The more important causes for each year are listed in Table VIII.

Conversations with A. Garnier and M. Feier, Department Biostatistique, were helpful in developing this information. A vigorous program to improve the quality of biostatistical information is now in progress.

DIETARY STUDY*

Prior to this survey, little effort had been made by any group to determine the nature of the Haitian diet. During the conduct of our study, "A Dietary Study in Haiti," by Faye W. Grant and Dale Groom was published (*J. Am. Dietet. A.*, 34: 708-716, 1958). They made a dietary study of seventy families in the La Saline area of Port-au-Prince. Their findings are essentially in agreement with our much more extensive observations. The only earlier information in the nutrition literature on the types of food, methods of preparation, nutrient intake, or dietary habits of the Haitian people is provided by a summary, "Une Enquete Alimentaire en Haiti" by Carlos

* The team making dietary studies included G. P. Barron, F. Berger, and C. E. French, assisted by M. Frederique and L. Gemeau.

Boulos (*Bulletin Le l'Association Medicale.* Haitienne, 6: 185-188, 1954). This was based on data obtained from sixty-five families in an area similar to that studied by Grant and Groom. Food Composition tables available from the United Nations and other agencies are inadequate for use in evaluating the nutrient intake of these people, as the diet includes a large variety of wild leaves and buds of unknown composition.

Methods

Most of the information in this report was obtained by diet history interviews. It was necessary to depart from methods that would give precise quantitative data on nutrient intake, since such methods require more time and personnel than were available. Diet histories are valuable only in obtaining qualitative information. Efforts were made to obtain information that could be used in a semiquantitative assessment of nutrient intake, but the data obtained are subject to the inherent inaccuracies of the diet history method.

Interviews were made and diet histories were obtained in all locations in Haiti where the clinical team worked. (Table I.) Most of the information was obtained from persons who visited the Public Health Dispensaries where the clinical team conducted examinations.

Some diet histories were obtained by interviews at home demonstration schools operated by the government in rural areas. At these schools, young girls (fifteen to twenty years of age) were interviewed. The teachers in these schools were of great help in providing information on the foods available in the area and the types of meals consumed by the people.

Visits were made to many homes in the rural areas where the housewife was interviewed. These visits had to be arranged by a government home demonstration agent, as the peasant housewife is reluctant to give information to foreigners who wish to observe her preparation of food. The cooperation and assistance of the local government agent overcame this problem.

In addition, local markets were visited to observe the types of food available and their current prices. This, too, necessitated the assistance of Haitian personnel in obtaining "true" market prices instead of inflated tourist prices.

It was fully realized that diet histories and interviews are of most value in determining food habits, patterns of intake and information of a qualitative, rather than quantitative, nature. Nevertheless, efforts were made to obtain as much quantitative data as possible while conducting interviews and recording diet histories. This was no easy task in that the average peasant has little knowledge of his food intake in terms of weight, and only slightly more knowledge of his expenditures for various food items.

Table IX was prepared from meager information obtained on food intake, which at best can be viewed only as approximate. The bulk of the information was obtained by ascertaining how much a family or individual spent in a week for a particular food item, then the intake (weight) was calculated on the basis of the current market price. The average intake per person was calculated by dividing the quantity of food by the total number of persons in the family. No adjustment seemed feasible to account for smaller intakes of children or larger intakes of adults, although such would have added much to the knowledge of actual food intake of these groups. The figures in Table IX represent the average intake of 460 persons (223 adults and 237 children under twelve years of age).

The method of arriving at the values in the table leaves much to be desired, but it was viewed as a feat of no small measure to obtain any definite information from the peasant class of people. Determining the number of persons comprising a family group might seem a simple chore to the average American, but difficulty was experienced in many instances. The peasant farmer often has two or three widely separated plots of land that he cultivates, and usually he has a "garden wife" and children at each plot to prevent the theft of his crops. It is understandable that often the number of wives and children, as well as his food purchases for the individual com-

TABLE IX

Calculated Intake of Some Foods* of 223 Adults and 237 Children (gm./person/day)

Food	Areas of Interviews										
	Average of all areas	Port-au-Prince	Carrefour	Mirebalais	Leogane	Furcy	Croix des Bouquets	Gonaives	Gros Morne	Pont de l'Estere	Cap Haitien
Beans	30	27	44	23	27	17	31	..	41	..	29
Rice	19	20	31	14	10	6	36	..	..	..	18
Corn	63	81	87	75	55	54	41	..	..	..	50
Millet	27	..	10	25	27	24	30	..	..	..	44
Bread	25	34	37	31	30	..	31	6	20	16	31
Bread of cassava	6	..	..	..	12	..	..	20	..	5	..
Fish	8	4	..	7	..	..	4	8	9	16	31
Meat	22	38	..	19	6	7	29	21	23	27	27
Milk†	85	..	..	32	..	109	76	200	86	15	77
Oil or lard	9	9	..	12	..	2	7	9	7	11	14
Plantain	100	..	66	130	88	..	..	..	..	117	..
Mangoes	420	136	..	630	525	..	263	630	420	472	525
Avocado‡	91	..	..	..	..	..	..	..	83	80	111
Sugar	40	50	..	..	..	42	27	..	..	..	..

* Values were calculated from data obtained by interview. Blanks in table do not mean absence of that food from the diet, simply that insufficient information was obtained through the interview.

† In areas where milk was reported only 34 per cent of those interviewed reported it.

‡ Corrected to edible portion; very seasonal.

ponents of his family, are matters beyond accurate memory of an illiterate head of a family. In many cases the head of the family could not give the number of children borne by his wives. One proud father reported fifty-two children, but it was not determined if this number was correct. Few peasants can count that high. The illiteracy made it difficult to obtain the ages of children in the family. Many mothers knew the number of children, but were unable to state their ages.

The sharing of food by neighboring families further complicated the calculation of food intake by the approach employed in this study. In some of the more poverty-stricken rural areas several families shared huts and available food. As many as twenty individuals ate from the same food pot, with all families contributing what they could to the day's food. It was an impossibility to get any useful information from persons living in such an environment and under such adverse conditions.

Table IX does not include all the foods that are normally found in the Haitian diet. Only those foods are listed on which some "semiquantitative" information was obtained as to their use. The absence of values in the table does not indicate that a particular food was not eaten in a given area, but simply that insufficient information was available as to the use of the food.

Several inconsistencies are evident in the values given in the table. For instance, it would appear that the average intake of meat was 22 gm. per day as calculated for this table. Actually, meat is usually reserved for the working males of the family and is not shared equally among the members. This fact was observed on visiting several peasant families, and confirmed by home economists or agents living in rural areas and having a good knowledge of the peasant food habits. Adult males, during interviews, denied their lion's share of the meat, but women repeatedly reported that most of the meat was given to the men of the family.

The use of the cereals, rice and millet, as listed in Table IX, does not agree with the

information of Table III pertaining to crop yields in Haiti. Rice is not consumed to the extent reported by the peasants, and perhaps twice as much millet is eaten. This is not startling in view of the pride of the peasant. Millet is referred to as the "poor man's rice" by higher classes of Haitians, and the peasant tended to overestimate his consumption of rice and underestimate his actual consumption of millet. A limited amount of rice is consumed by the peasant class because of its cost relative to corn and millet.

It would be fortunate if the average intake of milk was 85 gm. per person per day, as shown in Table IX. As a class, the peasants do not purchase milk, except in rare cases in which the mother feels her malnourished child will die if milk is not given. The use of milk was reported largely by families that possessed a cow, and milk was consumed when there was a surplus that could not be converted into cash. Only rarely was there a report of daily use of milk by a family, and then it was usually the children who consumed it. Reports of walking long distances to obtain milk for infants and young children were recorded. One mother reported walking 8 miles each week to purchase 1 L. of milk for a severely undernourished daughter. Four other children in the family sometimes shared the milk, making all shares insignificant.

Much discussion was given to the validity of the quantity of avocado reported as consumed. Members of the survey team who were natives of Haiti were in disagreement on the figure, 91 gm./man/day, some believing it too high and others being of the opinion that it was too conservative. All were in agreement that it would be difficult to estimate the intake of avocado for several reasons. Production varies with the regions, several sizes are available, and frequently the peasant has access to several of his own or a neighbor's trees from which he harvests at his desire. Under such circumstances, it is hard to estimate his intake. Of course many peasants do not live in regions where avocados are grown to any great extent, but still they are usually found in the local market during season and can be purchased quite reasonably.

Mangoes are consumed in great quantities, but as was the case with avocados, the quantity given in Table IX may be in error due to the inability of the average person to estimate his intake when the fruit is in season. There were reports of this fruit serving as the only food eaten during a day, but fortunately these were exceptions rather than the rule. However, it was obvious that when the fruit is in season mangoes contribute greatly to the average peasant's daily food intake.

Citrus fruits were not in season at the time of this survey and are omitted from Table IX due to indefinite information on their consumption.

An effort has been made to calculate the total daily nutrient intake based on the information presented in Table IX plus information obtained through other means, such as interviews with teachers and home economists in rural areas, observance of purchases at roadside stands and markets, and the direct observation of preparation of meals in the peasant homes. The summary of the data obtained is presented in Table X.

Group I of Table X lists the nutrients comprising the foods found in Table IX. In group II of the table other foods or groups of foods found in the average diet have been listed with the estimated intake of each. The total daily intake of nutrients is the sum of those in groups I and II. There is no claim to high degree of accuracy in the figures presented, but they represent the best information that was obtainable through the methods that were employed.

In a previous dietary study in Haiti, Grant and Groom (*J. Am. Dietet. A.*, 34: 708, 1958) reported a daily caloric intake for adults in the La Saline area of Port-au-Prince as ranging from 980 to 2,307 calories. In computing the daily intake of nutrients, children over six years of age were classified in the adult group. The average caloric intake of three family classes (all considered lower, but classified as to income into three categories) was 1,572 calories per adult per day. Lower intakes were calculated for the few rural families that were studied. The average caloric intake per person per day, as determined in the present study and reported in Table X, was 1,580

TABLE X

Estimated Nutrient Intake Per Capita Per Day

Nutrient	Consumed (gm.)	Energy (cal.)	Protein (gm.)	Fat (gm.)	Vitamin A (I.U.)	Vitamin B_1 (mg.)	Vitamin B_2 (mg.)	Niacin (mg.)	Ascorbic Acid (mg.)	Calcium (mg.)	Iron (mg.)
Group I											
Beans	30	102	6.6	0.51	9	0.16	0.05	0.69	0.09	41.1	2.61
Rice	19	68	1.3	0.21	0	0.04	0.01	0.72	0.0	2.7	0.19
Corn	63	224	6.0	2.71	284	0.28	0.07	1.26	0.0	4.4	1.45
Millet	27	92	2.6	0.81	0	0.08	0.03	0.27	0.0	8.1	1.08
Bread	25	60	2.3	0.65	0	0.08	0.03	0.75	0.0	24.0	0.55
Bread of cassava	6	20	0.1	0	0	0.0	0.0	0.10	0.0	0.7	0.10
Meat	22	31	3.5	1.76	4	0.01	0.04	0.70	0.0	2.0	0.42
Fish	8	6	1.1	0.09	0	0.0	0.03	0.12	0.0	1.7	0.05
Milk	85	55	3.0	3.00	119	0.03	0.15	0.09	0.85	101.2	0.09
Oil or lard	9	80	0.0	9.00	0	0.0	0.0	0.0	0.0	0.0	0.0
Plantain	100	75	0.8	0.30	200	0.04	0.05	0.70	11.00	9.0	0.50
Mangoes	420	168	1.7	0.40	7,980	0.05	0.25	2.52	201.60	46.0	1.68
Avocado	91	142	1.2	14.30	309	0.09	0.40	1.30	9.10	13.7	0.82
Sugar	40	148	0.0	0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	...	1,271	30.2	33.7	8,905	0.86	1.11	9.22	222.64	254.6	9.54
Group II											
Roots and tubers	170	165	1.9	0.5	950	0.14	0.06	0.85	32.00	47.6	0.06
Vegetables and leaves	125	27	2.5	0.3	3,546	0.08	0.15	0.76	56.30	124.0	1.73
Flour	20	73	2.	0.2	0	0.03	0.01	0.20	0	3.2	0.20
Sweets	10	44	0.8	1.6	3	0.01	0.01	0.50	0.50	3.8	0.20
Daily total	...	1,580	37.4	36.3	13,404	1.12	1.34	11.53	311.44	433.2	11.73

NOTE: Group I represents nutrients contained in foods listed in Table IX.
Group II represents nutrients contained in other foods found in average diet.

calories. No distinction was made for age groups in arriving at this figure but, naturally, the average intake for adults would be higher if some adjustment had been made for the smaller caloric intake of children.

Grant and Groom gave the average protein intake per day for adults in the three classes as 25, 42 and 68 gm. An average of the three classes would be about 44 gm. of protein per adult per day. Perhaps the figure arrived at in the present study, 37.4 gm., would approach or exceed 44 gm. for adults if adjustment could have been made for the intake of children. If it is true that most of the family meat is eaten by the working males, little or no animal protein is consumed by women and children. On the basis of the consumption of meat, fish, milk and eggs, one would conclude that animal protein is present in negligible amounts in the diet of the average peasant.

The average intake of fat, as reported in Table X, was 36.3 gm. per day, with almost half being contributed by the avocado. Therefore, it is reasonable to assume that the fat intake is drastically reduced when this fruit is not in season. Likewise, the intake of riboflavin would be reduced due to the importance of the avocado in providing this vitamin. The desire for fat by the peasant was evident, as reported elsewhere in this text, and certainly the diet could be improved if additional sources of fat were available. According to the figure,

36.3 gm., fat contributes only 21 per cent of the daily calories during the avocado season and much less when this fruit is not in season. Grant and Groom reported an average intake of 57 gm. per adult per day. The contribution of calories by fat in the Haitian diet is much less than that found in American diets in which approximately 44 per cent of the calories is contributed by fat.

The fondness for sugar and sweets was considered rather unusual in that most of the calories of the diet are contributed by carbohydrate or starchy foods. Rarely was a person interviewed who did not report the use of sugar or "rapadou" in his coffee. Four to six teaspoonfuls of sugar are usual quantities used, an amount that would be considered excessive by the most ardent sugar-loving American. Further, sugar is used in large amounts in leaf teas, "bouillie" (corn or wheat flour plus milk, coconut milk or water and sugar), and in "acassant" (finely ground corn cooked with a little water or milk and sweetened). In addition, most children and adults reported weekly purchases of cola (a bottled drink containing 12 to 15 per cent sugar) and candies of various sorts. A peanut brittle-like candy, "tablett," was a favorite that could be purchased in even the remotest areas from vendors who peddled their wares along roads and trails. Baked pastries were not eaten in great quantities by the average peasant, perhaps due to the cost, but it was noticed that the sale of these in the cities was good. No reasonable estimate could be made of the carbohydrate intake through the chewing of sugar cane by all age groups.

The value listed in Table X for the daily consumption of sugar (or "rapadou"), 40 gm., is higher than that reported by Grant and Groom for the two lower classes (15 and 25 gm.), but the information obtained in the present study would not indicate 40 gm. as being excessive. This figure does not include carbohydrates consumed in "sweets" such as sugar cane, cola, candies and pastries.

Reference has been made to the study conducted by Grant and Groom in the La Saline district of Port-au-Prince. Some information for the present report was obtained from the same district, but most was obtained in rural areas from the peasant class of people who are in the majority in Haiti. The activities and habits of the peasants are somewhat different from those of the people living in La Saline. Poverty is one thing the two groups have in common.

Food Costs

A survey conducted by government workers and reported in a Haitian publication (Bull. Trimestriel de Statistique No. 24, 1957) indicated that the average peasant family (4.9 persons) spent about 44 cents per day for food, or about 9 cents per person. These figures are subject to errors in the translation of the Haitian report, but from the information obtained in the present study and reported herein, it would be the opinion that 44 cents per family per day is slightly in excess of the average expenditure by the average peasant family. An estimate of 30 to 40 cents per family was made in the present study. Grant and Groom reported a range of 5 to 27 cents per adult per day for classes living in La Saline.

Table XI shows the costs of some commonly used foods at Cap Haitien and Port-au-Prince markets during the month of July. These are urban markets where prices are often inflated to take advantage of the normally higher income of the urban dwellers. Slightly lower prices prevail in the country markets, especially for fruits and vegetables.

Number and Types of Meals

The average peasant never eats more than two meals per day, not counting the "breakfast." The family rises early and breakfast consists of coffee or a leaf tea sweetened strongly with brown sugar or "rapadou," a heavy, thickened molasses, and a biscuit (30 to 35 gm.) purchased the preceding market day. In addition, the man of the family often drinks about $\frac{1}{2}$ ounce of native rum (clairin).

The next meal usually takes place between 11 A.M. and 3 P.M. when work in the fields has ended. If it is the earlier hour, usually it is quite light and consists of one plantain with a small amount of dried cod fish or herring, or plantain plus a sweet potato, or just a dish of corn plus beans. If work is not completed

TABLE XI

Costs of Some Commonly Used Foods at Cap Haitien and Port-au-Prince Markets During the Month of July*

	Cap Haitien (cents/lb.)	Port-au-Prince (cents/lb.)		Cap Haitien (cents/lb.)	Port-au-Prince (cents/lb.)
Meat and fish:			Cabbage, head	...	7
Beef, regular cuts	20–30	20–25	Cabbage, leaves	3	2
Beef, trimmings	10	12–16	Eggplant	4	4
Cabrit (goat)	...	22	Leek	11	10
Pork	20–32	...	Mirliton leaves	3	3
Fish, smoked	32–42	30	Okra	7–8	5–6
Fish, salted	24–30	22	Peas	6–7	5–6
Fish, fresh	20–40	...	Pumpkin	4–5	6
Cod fish, dried	36	35	Tomato	12	10
Conch, dried	30–45	26	Watercress	10	9
Crabs, fresh	15	18	Fruits:		
Beans:			Apricot	...	3–4
Beans, red	9–10	14–15	Avocado, small	3–4 for 1¢	...
Beans, black	...	12	Avocado, large	...	2
Cereals and cereal products:			Guava	2	2–
			Lime	1	2
Corn	4–5	6	Mango	1	1/2–1
Corn meal	8–10	5	Oranges	...	3
Corn flour	7	10	Pineapple	3–5	4–5
Millet	10	6–7	Nuts:		
Rice	10	12	Cashew, shelled	12	18
Rice, parboiled	10–12	14	Peanuts, unshelled	...	10
Wheat flour	10–12	10	Peanuts, shelled	10	14
Biscuit†	11–16	14–15	Sugars and sweets:		
Macaroni	30	20	Sugar, brown	...	6
Vermicelli	...	20	Sugar, white	...	8
Roots and starchy foods:			Bonbon‡	...	11
Breadfruit	2	3	Douce (candy)§	...	18
Yam (igname)	2	3–6	Tablett (candy)‖	...	18
Yautia (malanga)	4	6	Sugar cane	2–3 ft. for 1¢	...
Potato	10	6			
Sweet potato	2–3	4	Fats and oils:		
Plantain	4	5	Cottonseed oil	32	30
Cassava (manioc)	2	...	Lard	...	28
Cassava bread	...	9	Miscellaneous:		
Fresh vegetables:			Eggs	20–24¢ per doz.	18¢ per doz.
Beans, green	6	6			
Beans, young cut	18	18	Salt, crude	2	1

* Costs were determined by visiting the markets and bargaining with the personnel until what was considered the true market price was obtained. The product was then weighed in order to estimate the cost per pound.

† Small rolls are referred to as "biscuit."

‡ Cake-like pastry of various kinds is referred to as "bonbon."

§ "Douce" is various flavored candies made of milk and sugar.

‖ "Tablett" is a favorite candy of young and old and is made much like peanut brittle. Cashews are often used instead of peanuts.

until 2 to 3 P.M., a much heavier meal is consumed. It may consist of corn, millet or rice with red beans or "bouillon," a favorite dish. The bouillon may contain a small amount of meal, an assortment of vegetables, many wild leaves, and one or more of the "vivres alimentaires" (plantain, sweet potato, yautia and yam). Often a bit of wheat flour dough is added in the form of small balls for "dumplings."

About dark the second meal of the day is eaten. If the lunch is light the second meal will be of the nature of the heavy lunch, that is, it will consist of a cereal with beans or bouillon.

On the other hand, a heavy lunch usually means that the night meal will be light and will consist of a sweetened corn or wheat flour mush, or a baked plantain or sweet potato, or just a cup of leaf tea with a biscuit. Fruits are not normally eaten with meals, except plantain. Mangoes, oranges, grapefruit and avocados are eaten in goodly quantities in season at any time during the day. Sugar cane in season is chewed between meals by nearly all the people in the sugar cane areas. From a caloric standpoint, the daily diet is considerably augmented during the fruit and sugar cane seasons.

Leafy green and yellow vegetables are grown in all areas that were visited, except in the Furcy area where a two-year drought has severely curtailed the production of food. In some areas a definite preference for certain vegetables was noted. For instance, in the Mirebalais area eggplant, cabbage and squash were preferred and used more frequently than other vegetables. This probably is due to the fact that the area is better suited for the production of these crops than for others, and more are available for consumption. Watercress was the preferred vegetable in the diet of persons living where this crop grows profusely near rivers and streams. Naturally, vegetables are seasonal, as are fruits, but the best information is that there are many in season during all times of the year. The average peasant does not buy vegetables often. If he does not produce them, he seldom eats them. The most unusual observation made during the survey was that quantities of wild young green leaves and buds are consumed by the people in all areas. These leaves are listed in Table IV. It is sufficient to say that many types are used. As a group, these leaves are the most important fresh green vegetable in the Haitian diet. Of course, they are used in such quantity because they are an expense-free item of food (except in the cities where they are sold in the markets at a very low price). The composition of these leaves is unknown at the present time, but judging by the composition of known leaves similar to these, there can be little doubt that their consumption in such quantities contributes greatly to the riboflavin and carotene intake of the people.

Preparation of Food

Little effort goes into preparing and cooking the meals in Haiti. One pot over a small, round charcoal burner is used, and into this pot go all ingredients of the meal. With rare exceptions, all foods are boiled. One of these exceptions is the preparation of "Tom-Tom" (baked plantain or sweet potato). In this case a little oil or grease is applied to the plantain or potato and it is put directly on the charcoal fire. After baking, it is then pounded into a flat cake, spices or salt are added, and it is eaten in this form. An alternative Tom-Tom recipe specifies boiled breadfruit, plantain and sweet potatoes reduced to paste consistency in a wooden mortar. This paste is pressed compactly in cloth, cut and eaten with okra bouillon. Also, a salted fish is often prepared by placing it directly over the fire.

The meals always contain a bit of added oil or fat put directly into the pot. When no oil is available, grated coconut meat is put in for its oil content. Fried foods are not prepared in the home. On market days, it is possible for the peasant to obtain a small fried fish (deep fried) for 1 or 2 cents. Rarely does he eat or purchase such an item.

It should be mentioned that little is done to the food prior to its introduction into the pot, except removal of peels from tubers, etc. Of interest is the fact that meat is usually rubbed with juice of the citron (the sour orange) prior to cooking. The same treatment is given one or more of the roots and tubers. The purpose of this treatment was not determined.

Meat (beef, goat and pork) and fish are usually purchased in small amounts only on market days (twice a week in most areas; only once a week in remote areas). The lack of refrigeration makes it imperative that meat be eaten immediately. If the fish is salted, it is usually saved and eaten later in the week. Thus the native dish, "bouillon," may or may not contain animal protein.

Milk is seldom consumed in any quantity by the average family. It is never used as a beverage except for very young children. When it is bought and used by the average family, it is usually added to the "bouillie," the sweetened corn or wheat flour mush. More often this dish is prepared with water or coconut milk.

Eggs are rarely consumed by the peasant class since they are choice marketable items. It was judged that egg production is too small to contribute much to the nutrition of the people of Haiti. Poultry meat is eaten by the average family only a few times a year on certain religious holidays.

Schools and Orphanages, Dietary Information

La Saline, a waterfront district in Port-au-Prince, is composed of families of low economic status. The clinical team conducted physical examinations of children at a public school in this district, and an effort was made to obtain some information on the dietary habits of these children. Children were questioned as to the number of meals they ate each day, what kinds of food they ate and how much. The answers followed such a strict pattern that it was soon realized that the children were not giving information on their own dietary habits but were repeating what had been taught them pertaining to good food habits. The male teacher of the school expressed his opinion that his children seldom ate over one meal per day, and that sugar cane, when it was in season and plentiful, sometimes served as the only nourishment for a day.

Somewhat more definite information was obtained as to the diets of children in La Saline when a visit was made to a day school for girls operated by the Catholic church. There were 250 girls, with an age range of eight to twelve years, attending morning classes at this school. In mid-morning a small roll (25 to 30 gm.) was served each girl, and a lunch was served at noon. A budget of $80.00 was allowed to finance the lunch program for twenty days per month, or about 1.6 cents per girl per day. Obviously, the lunches were quite simple, and usually consisted of corn or millet, red beans and sweet potatoes. The supervising personnel estimated that each child received a daily average of 0.3 pound of millet or corn, 0.2 pound of red beans and 0.2 pound of sweet potatoes. These figures were based on the weekly purchases. A direct observation of meal preparation and the serving of lunch led team members to the conclusion that the daily intake was perhaps one-fourth less than the amounts estimated by the school personnel. Rice was seldom substituted for corn or millet because of its cost, and fresh vegetables were seldom served for the same reason. An effort was made to serve some form of meat, pork or fish, usually as a component of some stew, about once every week or two. The quantities of these products could not be estimated by the supervising personnel.

Although meager by American standards, the lunch program was a strong incentive for attending school. Many girls reported that their school lunches were the only meals they received during the day. A few reported that they received sweetened tea or a cola drink (for an evening meal) in their homes. There is no doubt that nourishment was provided in addition to the school lunch, but perhaps these lunches provided the major portion of the nutrient intake of these girls. By American standards the girls appeared underweight, but their spirits were high, especially before lunch, and their attendance records were excellent. (Clinical examinations were not conducted at this school.) The teachers noted a marked improvement in the performance and alertness of the girls when the school began serving the small roll in mid-morning. Most of the teachers were convinced that 90 per cent of the daily food intake of these girls was provided by the school program.

It was most gratifying to visit a government-operated school for orphan and delinquent boys in the Carrefour area, a suburb of Port-au-Prince, and to observe the facilities for caring for 362 boys ranging in age from about eight to sixteen years. The assistant director and the "cook-dietitian" were most cooperative in discussing the diets used at the school and urged the team members to visit the kitchen and dining area. No records of food purchases were available for examination, but a figure of

22 cents per boy per day was quoted as the budget for food purchases. A visit to the dining area during the lunch hour convinced team members that the boys were receiving ample quantities of food. The lunch consisted of rice, beans, a green leafy vegetable and plantain. The inclusion of a vegetable with a rice and bean meal is an exception in most of Haiti where beans and a cereal, alone, make up a meal. Seldom did we find the inclusion of another food with this type of meal. The cook, who also did all the meal planning, indicated that she had no training in dietetics or nutrition, yet it was evident from her survey of the diets she served that the quality was superior to the average found in Haiti. Milk was served daily in limited amounts (about 150 ml. per boy), yet this is much in excess of the national average. Meat (100 gm. per boy) was served daily except Friday when fish was used. A wide variety of vegetables was used in the meal planning, but fruits were used in a limited way. Again, contrary to the national picture, little sugar and sweets were included in the dietary of these boys. There was no doubt that the diet received by students at this school was far superior to that consumed by boys of comparable ages in the average family in Haiti. Of course the expenditure of 22 cents per boy per day for food would be exorbitant, if not prohibitive, for the average family.

In contrast to the conditions found at the Carrefour school, a struggle to maintain an adequate intake of nutrients was observed at a public orphanage in the suburbs of Port-au-Prince. Here, forty-six children, ranging in age from about two to ten years, were under the care of eight adults. The monthly budget for operation of the institution (excluding salaries) was $200. The food budget depended on the balance remaining after deduction of expenses for soap, charcoal, and transportation for the personnel. In case of emergency, food dollars had to be used for medicines and care of the ill, although normally these expenses would be handled by the government. The supervisor in charge would not make an approximation of her food expenditures for the children, but was sure that the food budget varied tremendously from month to month, depending on other expenses. The eight adults ate their meals at the institution, and thus it was indefinite just how much in terms of quantity or costs could be assessed to each child's food allowance. Perhaps 7 or 8 cents per day would not be unreasonable.

Credit was certainly due the supervisor in view of her efforts to feed the children adequately with such a small budget. She provided three meals per day regardless of circumstances, and seemed aware of the shortcomings as to quality and quantity of certain meals she was forced to serve at times. Fruit, bread with margarine, and milk were served for breakfast when milk could be afforded. If fluid milk was not available, scrambled eggs were served (only twelve for the entire institution), using powdered milk in the process, and the usual bread or two rolls with margarine. Lunch was usually only beans with rice or corn; however, sweet potatoes or a vegetable was sometimes included. The evening meal usually consisted of a meat and vegetable stew (4 to 5 pounds of meat and one or more of the various vegetables) and bread with margarine. Fish was served in place of meat on Fridays. Often the budget prevented the serving of meat during the latter days of the month, in which case vegetable soups were served at the evening meal. Often the children were given a roll and a cup of sweetened tea made from cotton leaves, cinnamon or tibaume prior to going to bed at night. A variety of fruits was given the children for breakfast and occasionally fruit or fruit juice was served between meals. This was one institution that seemed to make full use of the juice of the sour orange, a fruit that is plentiful in Haiti, yet seldom regarded as a useful product. Sweetened with sugar, this juice is very appetizing. By necessity, this institution used several of the wild leaves which can be purchased quite reasonably, and when the food budget permitted, a variety of vegetables was used. Over-all, the quality of the diet at this orphanage was above the national average, but the quantity of food per child appeared very limited.

A parochial orphanage for girls, located near Port-au-Prince, was visited while the clinical team was conducting examinations there.

There were seventy-four girls ranging in age from six to twelve years at this institution. The food budget was approximately 33 cents per girl per day, an amount which was considerably more than allowed the other institutions which were visited. Needless to say, the quantity of food per girl was above the national average, but due to the lack of knowledge of nutritional requirements, there was much to be desired as to the quality of the diets served. Fruits were seldom used in any way, yet there were sour orange trees growing on the grounds of the institution. Mangoes were abundant and cheap, but they had only been given at one meal (a month previous). From the best estimate, the last citrus fruit of any kind had been given the girls two months previously when each received an orange. Usually an effort was made to give a banana to each girl on Sunday, but the importance of fruit in the daily diet was not recognized. Vegetables were usually served as components of soup and seldom were used to balance meals composed mainly of beans and cereal. These vegetable soups, served with bread and butter, were characteristic of the evening meals. Vegetables were not included in meals when meat or fish was served. The girls at this institution were fortunate in having a daily supply of milk, above average quantities of meat, fish and other foods (except fruit), but their diets could have been improved greatly through a better understanding of the essentials of adequate nutrition on the part of personnel in charge of meal planning.

From the few visits made to schools and institutions, it was concluded that nutritional standards could be improved if the services of a trained nutritionist or institutional dietitian could be provided to advise and assist in planning a good nutritional program. The government would profit from such a service in that maximum benefit could be derived from the money allotted these institutions for food. At each institution visited personnel in charge of food services expressed a desire to learn how they could improve the diets of the children. One dietitian for the entire Port-au-Prince area could render a great service to these schools and institutions.

COMMENTS

A careful analysis of food production in Haiti leads to the following general conclusions:

With the exception of three major items (wheat flour, fish, and edible oils), the Republic is or might be made to be self-sufficient with respect to nutritional requirements. The possibility that the requirement for wheat flour will diminish is slight, but the substitution of imported wheat for wheat flour will provide by-products for local use. The plan to enlarge Haitian fisheries, if successful, will help to replace in part the importation of fish and, eventually, to increase the consumption of high quality protein. The situation with respect to edible oils is less promising but any improvement in the production of cotton would alleviate some of the shortage. Studies are in progress to test the possibility of substituting an annual, rapidly maturing cotton (Stoneville 2_B) for the perennial type now in use. The U.N. Mission in 1948 recommended that the African oil palm be introduced in large numbers as a source of oil. No appreciable progress has yet been made in this direction. Small amounts of palm oil are seen occasionally in the local markets.

With respect to other crops, yields can be increased appreciably by means already known. The use of fertilizer and insecticides may be cited. New or improved plant varieties can be introduced. Irrigation, where possible, is known to increase yields as shown in Table XII. Soil conservation and reclamation tech-

TABLE XII

Effect of Irrigation on Yields of Haitian Crops

Crop	Yields	
	Non-Irrigated (lb./hectare)	Irrigated (lb./hectare)
Rice	2,500	5,000
Corn	1,500–2,250	2,500
Millet	1,250	3,750
Cassava	20,000	30,000
Sweet potato	6,500	18,000
Plantain	500 stems	1,700 stems

NOTE: Estimates from the Department of Agriculture of Haiti, Damien.

nics can be adopted. By the use of any or a combination of these methods it is believed that the productivity of Haitian farm land (including livestock) can be greatly increased. However, it is believed that illiteracy and lack of capital are tremendous handicaps to any of these developments. It is obvious that if a farmer cannot read, he is extremely hard to teach. Similarly, if he has no money, he cannot buy fertilizers and insecticides even if he knew enough to do so.

Therefore, two important programs which should be activated immediately are: (1) improved adult and child education and (2): increased rural credit facilities.

The revision of land tenure (discussed in detail by the U.N. Mission) will have to be undertaken at some time in Haiti's future or her farm population pressure will be overwhelming.

With respect to the availability of total food and of the proper kinds of foods, it is believed that here again increased capital and education are paramount. The necessary foods are or can be made to be accessible in the markets. Usually there is not sufficient money to buy, but, even when there is, lack of information on good nutritional practices prevents the proper selection of foods. For his cash crops the peasant will plant what he thinks he can trade to most advantage. Unless he is assured of more money for his bean crop, he does not care to plant beans on the land which he is now using for corn. He does not know that his children will profit more from eating beans than from eating corn. Only combined economic and educational pressures will force the necessary nutritional changes.

The results of this survey show that the Haitian suffers from lack of sufficient food, and that the food he eats is lacking primarily in protein. Providing the necessary increase in calories of any kind is a socioeconomic problem involving land tenure, farm prices, credit, etc. In general, farm production must be increased to meet the need, and the means for doing this are known.

Increasing the protein content of the diet is a more immediate objective. This can be accomplished by increasing the amount and quality of vegetable and cereal proteins, or of meat, eggs, milk and fish. The most available proteins are the dried beans which already form a substantial portion of the Haitian diet. Any increase in this dietary constituent would be of value. Work is required to determine the relative protein values of the red bean, the pigeon pea (pois congo) and the blackeyed pea (pois inconnu), and to work out those mixtures with the popular cereals (corn, millet and rice), which will give maximum utilization of proteins.

Quality of the Haitian Diet

The diet of the average person remains in a relatively fixed pattern. It can be divided into three types of meals: (1) meals in which beans serve as the most important source of protein; (2) meals in which meat serves as the main source of protein; and (3) meals in which fish is the main source of protein.

Type 1 meals are usually higher in protein than the other two types because of the percentage of cereal (corn, millet or rice) that is consumed with the beans. However, the protein quality is poor compared to types 2 and 3. Further, meals of type 1 seldom include any additional class of food, and the absence of green or yellow vegetables and fruits indicates that it is inadequate in calcium and vitamin content (except perhaps thiamine). Thus, from the standpoint of protein quality and vitamin and calcium content, one would conclude that this type of meal is poor nutritionally.

In the type 2 meal, meat is nearly always accompanied by fresh vegetables and leaves and tubers. This meal would be considered the best type of meal consumed in Haiti. The contribution of vitamins and calcium by the vegetables and tubers, along with the high quality protein of the meat, makes this meal much superior to type 1. However, this meal could be improved with the addition of more protein.

Type 3 meals are fish with plantain and perhaps a sweet potato now and then. Because of its protein of good quality, this meal would rank next to type 2 in nutritional value. It is inadequate in vitamins A and C and could be vastly improved with the addition of a fresh fruit or vegetable.

Perhaps it should be said that all three meals could be improved from the caloric standpoint, because in the quantities usually consumed, these meals are probably low in caloric value. One exception might be the cereal plus bean type meal. All three meals are low in fat content.

It must be understood that these three types of meals are not consumed every day. As mentioned previously, meat is eaten soon after market day and before it can spoil, while salted fish is held to be used later in the week. Beans and the cereals appear more frequently in the diet, as they are more or less staples for the family.

In view of the limitations of each type of meal in nutritive value, it might be concluded that the average peasant diet is inadequate in protein (quantity and quality). It is deficient in calories due to its low fat content. The riboflavin content is apt to be very low. Fortunately, the peasant does not have to rely only on these three types of meals for his total nutrient intake. The abundance of fruit in Haiti, especially citrus, mangoes and avocados, plays an important part in the peasant's nutritive condition. He freely partakes of these fruits when in season, at any hour of the day.

Citrus fruits are available in quantities from November through February. Mangoes are in season from June through October. The avocado season lasts for about four months during the summer and early fall. It is only during the spring months that fruits become relatively scarce and too expensive for the average family.

Vitamin C deficiency should be non-existent at least nine months of the year due to the daily consumption of citrus fruits and mangoes. The vitamin A intake should be extremely high during mango season when the peasant may eat 6 to 10 mangoes per day. In other seasons, vitamin A intake may decline, but the use of many green leaves in the diet should prevent any deficiency of this vitamin.

The avocado is a fruit of extreme importance to the peasant diet. Its high fat content and unusually high content of riboflavin make it an ideal fruit to supplement the average diet that is deficient in both of these nutrients. Quantitative information on the daily consumption was sparse, but when avocados are in season, the average peasant will eat 1 to $1^1/_2$ medium sized avocados per day. This is an invaluable addition to his daily riboflavin intake, and adds important amounts of fat. Unfortunately, the season is only three or four months of the year, thus it is likely that borderline and true deficiencies of riboflavin exist in some of the population during other months of the year. It is suspected that the consumption of wild green leaves in such quantities may reduce widespread riboflavin deficiency, since milk and milk products are used very little. The composition of these various leaves is not known at present, but it is known that wild leaves (especially the dark green ones) in other countries contain relatively large amounts of riboflavin. The possibility also exists that one or more of the frequently used species in Haiti could be unusually high in riboflavin content.

Thus, judging from the types of meals consumed in the average peasant family and the various fruits that are eaten between meals, the daily nutrient intake is no doubt low in protein (quantity and quality) and low in fat and calories. The vitamin intake may be satisfactory most of the year, except for riboflavin. The calcium and iron intake, while not high, may be adequate to prevent deficiencies of these two elements.

Improvement of the Diet

It would be simple to say that the daily diet could be improved by the addition of more meat, milk, eggs and fat, and that the peasant should have his fruit juice for breakfast every day of the year. Such suggestions are of little value to a population with such limited income and such fixed dietary habits. More meat and fish would be consumed if the people could afford them. Many peasants expressed a desire to give milk to their children but were financially unable to do so. However, the adult population would not be apt to use milk or milk products even if money were

TABLE XIII
Frequency of Evidence of Malnutrition

Analysis	Questionable Ranges (Less Than)	% of Population in Questionable Range
Total plasma protein	6.4 gm /100 ml.	15
Plasma albumin	3.9 gm./100 ml.	55
Hemoglobin	12 gm./100 ml.	13 (33, of pregnant women)
Plasma ascorbic acid	0.2 mg./100 ml.	8
Plasma vitamin A	20 μg./100 ml.	7
Plasma carotene	40 μg./100 ml.	2
Urinary thiamine	66 μg./gm. creatinine	29
Urinary riboflavin	80 μg./gm. creatinine	2
Urinary *N*-methyl nicotinamide	1.6 mg./gm. creatinine	19

available. An improvement in poultry breeds and production might well lower the cost of poultry and eggs to the point where the average family could purchase more. It would also be helpful if more families could raise their own poultry and eggs and would not have to rely on ready cash for the purchase of animal protein.

If the peasant could be encouraged to change his dietary pattern, he could improve his diet and nutritive status without increasing his food budget. The corn, millet, rice and beans type of meal could be improved by the addition of fresh vegetables or leaves. It would be further improved if just a little of the meat of type 2 meals were included in this meal. Likewise, type 3 meals would be greatly improved if the fish and tubers or plantain were supplemented with a green vegetable. Meat meals of type 3 would be improved from the calorie standpoint by addition of cereal to the meal.

In view of the nutritional value of the avocado, the peasant should be encouraged to eat this fruit regularly and in quantity during the months that it is available. The use of avocado as a regular component of daily meals might be a good way of insuring that all members received an adequate portion and might establish a pattern of eating fruits along with the three types of meals.

To insure against vitamin C deficiency during the early spring months, or when the fruit supply is low, the use of fruit jellies could be recommended. The goyave jelly is easily prepared and contains substantial quantities of vitamin C. This jelly and others could be prepared during the fruit seasons and saved for use in the months when vitamin C intake is apt to be low.

BIOCHEMICAL EXAMINATIONS*

Methods

Blood and urine samples were obtained from 454 persons, approximately 15 per cent of those examined. The selection of individuals from whom these specimens were obtained was not uniform because of varied circumstances. There was usually an attempt at random sampling, i.e., every tenth person was examined. In a few instances samples were requested in order to attempt individual correlations with clinical findings. All blood samples were drawn by a Haitian physician. A sample of 20 ml. of venous blood was drawn from each person selected for biochemical examination. The blood was collected in a "vacutainer" tube containing 40 mg. of Heller and Paul oxalate mixture. The blood samples were transported on a daily schedule to the laboratory in Port-au-Prince for analysis.

In addition, urine samples were collected in plastic bottles and a 30 to 50 ml. aliquot

* The biochemical laboratory team included B. L. Reid, G. P. Barron, G. L. Brinkman, J. Foucault, K. W. King, S. C. Smith and F. Vital.

was transferred to a brown bottle containing approximately 50 mg. of oxalic acid and 0.1. ml. of hydrochloric acid.

All samples were placed in insulated cans and packed with ice for transportation to the base laboratory. All blood analyses were completed the following day—delays in the arrival of equipment made it necessary to store the urine samples in a freezer. The maximum storage time for the samples obtained during the first two weeks of the survey was one to two weeks, after which time all analyses were completed within one day after collection. Since fasting urine samples were not feasible under the conditions of the study, all urine values were expressed on a per gram of creatinine rather than on a time basis.

The laboratory procedures employed are detailed in the ICNND Manual for Nutrition Surveys (revised 1957 edition). The low creatinine content in a number of samples made it advisable to use 0.2 ml. of urine for this determination. The N'methylnicotinamide method was performed as outlined except that all urine samples were decolorized with charcoal before analysis. The plasma vitamin C level was estimated by the use of the 2,6 dichlorobenzenone indophenol procedure.

The acid hematin method was used for the estimation of hemoglobin content, with the iron determination of Wong (*J. Biol. Chem.*, 77: 409, 1928) being employed to standardize the procedure. Plasma protein and albumin were determined by the biuret reaction employing the procedure of Wolfson (*Am. J. Clin. Path.*, 19: 723–730, 1948).

TABLE XIV
Summary of Biochemical Findings (All Locations)

Total Plasma Protein (gm./100 ml.)

Range	<6	6–6.4	6.5–7.0	>7.0	Total
No.	24	42	70	318	454
%	5.3	9.3	15.4	70.0	100

Plasma Albumin (gm./100 ml.)

Range	<3	3.0–3.9	4.0–5.0	>5.0	Total
No.	37	195	164	25	421
%	8.8	46.3	39.0	5.9	100

TABLE XIV (*Continued*)

Hemoglobin (gm./100 ml.)

Range	<10	10.0–10.9	11.0–11.9	12.0–13.9	14.0–14.9	15+	Total
No.	12	13	20	97	69	145	356
%	3.4	3.6	5.6	27.2	19.4	40.8	100

Mean Cell Hemoglobin Concentration (gm./ml. packed cells) × 100

Range	<28	28.0–29.9	30.0–33.9	34.0 +	Total
No.	9	7	81	238	335
%	2.7	2.1	24.2	71.0	100

Plasma Vitamin C (mg./100 ml.)

Range	<0.10	0.10–0.19	0.20–0.39	0.40+	Tota
No.	20	13	38	339	410
%	4.9	3.2	9.3	82.6	100

Plasma Vitamin A (μg./100 ml.)

Range	<10	10–19	20–49	50+	Total
No.	1	20	170	96	287
%	0.3	7.0	59.3	33.4	100

Plasma Carotene (μg./100 ml.)

Range	<20	20–39	40–99	100+	Total
No.	0	7	86	258	351
%	0.0	2.0	24.5	73.5	100

Urinary Thiamine (μg./gm. creatinine)

Range	<27	27–65	66–130	130+	Total
No.	41	88	113	199	441
%	9.3	20.0	25.6	45.1	100

Urinary Riboflavin (μg./gm. creatinine)

Range	<27	27–79	80–270	270+	Total
No.	2	5	142	302	451
%	0.4	1.1	31.5	67.0	100

Urinary N'-Methyl Nicotinamide (mg./gm. creatinine)

Range	<0.5	0.5–1.59	1.6–4.3	4.3+	Total
No.	9	75	233	136	453
%	2.0	16.6	51.4	30.0	100

TABLE XV—Biochemical Findings by Per Cent of Standard Body Weight

	Standard Weight Range					
	<70%	70–79%	80–89%	90–99%	100–109%	110%+
Plasma protein (gm./100 ml.)	Number of Determinations					
	14	73	163	143	50	17
	Per Cent Distribution					
<6	7.1	5.5	4.3	6.2	6.0	6.2
6–6.4	0.0	8.2	6.1	9.7	18.0	6.2
6.5–7.0	7.1	4.1	14.1	14.6	30.0	31.3
7.0+	85.8	82.2	75.5	69.5	46.0	56.3
Plasma albumin (gm./100 ml.)	Number of Determinations					
	10	69	131	133	46	16
	Per Cent Distribution					
<3.0	41.7	14.5	8.3	5.3	10.9	0.0
3.0–3.9	24.9	42.0	48.9	45.1	69.5	43.8
4.0–5.0	33.4	37.7	35.9	41.4	17.4	56.2
5.0+	0.0	5.8	6.9	8.2	2.2	0.0
Hemoglobin (gm./100 ml.)	Number of Determinations					
	10	67	121	114	40	13
	Per Cent Distribution					
<10	10.0	4.5	2.5	3.6	...	7.7
10.0–10.9	10.0	...	4.1	5.4	5.0	...
11.0–11.9	...	4.5	6.6	5.4	5.0	...
12.0–13.9	10.0	35.8	23.1	31.5	27.5	23.1
14.0–14.9	30.0	19.4	24.0	14.4	12.5	23.1
15+	40.0	35.8	39.7	39.7	50.0	46.1
Mean cell hemoglobin concentration	Number of Determinations					
	10	64	111	109	37	13
	Per Cent Distribution					
<28	...	1.5	2.7	2.7	2.7	7.7
28.0–29.9	...	...	1.8	2.7	...	7.7
30.0–33.9	30.0	32.8	20.7	22.0	21.6	...
34.0+	70.0	65.7	74.8	72.6	75.7	84.6
Plasma vitamin C (mg./100 ml.)	Number of Determinations					
	12	71	132	132	42	15
	Per Cent Distribution					
<0.10	8.3	2.8	6.8	3.0	7.1	0.0
0.10–0.19	8.3	4.2	3.0	3.8	2.4	0.0
0.20–0.39	33.4	12.7	6.1	9.2	4.8	6.3
0.40+	50.0	80.3	84.1	84.0	85.7	93.7

TABLE XV (*Continued*)

Plasma vitamin A (μg./100 ml.)	Number of Determinations					
	8	59	108	85	30	8
	Per Cent Distribution					
<10	0.0	0.0	0.0	1.6	0.0	0.0
10–19	25.0	10.2	8.3	4.6	3.3	0.0
20–49	50.0	49.0	60.1	40.5	73.4	45.5
50+	25.0	40.8	31.6	33.3	23.3	54.5
Plasma carotene (μg./100 ml.)	Number of Determinations					
	11	67	129	105	32	9
	Per Cent Distribution					
<20	0.0	0.0	0.8	0.9	0.0	0.0
20–30	0.0	1.5	1.5	1.9	3.2	0.0
40–99	45.5	31.3	17.0	15.5	37.5	11.1
100+	54.5	67.2	80.7	81.7	59.3	88.9
Urinary thiamine (μg./gm. creatinine)	Number of Determinations					
	12	79	164	131	47	16
	Per Cent Distribution					
<27	8.3	12.6	7.3	7.5	8.6	25.0
27–65	16.6	22.8	18.3	17.6	25.5	18.7
66–130	50.0	20.3	53.8	23.7	25.5	37.5
130+	25.1	44.3	50.6	51.2	40.4	18.8
Urinary riboflavin (μg./gm. creatinine)	Number of Determinations					
	11	75	161	136	51	15
	Per Cent Distribution					
<27	0.0	0.0	0.6	0.0	0.0	6.7
27–79	0.0	0.0	2.5	0.7	0.0	0.0
80–270	7.7	33.6	32.9	30.9	31.4	33.0
270+	92.3	65.4	64.0	68.4	68.6	60.3
Urinary-N′-methylnicotinamide (mg./gm. creatinine)	Number of Determinations					
	14	79	156	135	50	15
	Per Cent Distribution					
<0.5	0.0	3.8	2.6	0.7	2.0	0.0
0.5–1.59	14.2	17.7	17.3	14.9	20.0	20.0
1.6–4.3	42.9	46.9	50.7	53.0	54.0	40.0
4.3+	42.9	31.6	29.4	31.4	24.0	40.0

TABLE XVI

Summary of Biochemical Findings by Location*

	Location												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total or Average
	Number of Determinations												
Plasma protein (gm./100 ml.)	11	41	54	21	33	38	70	39	59	14	44	30	454
	Per Cent Distribution												
<6	...	9.8	1.8	4.8	9.8	...	...	5.1	3.4	7.1	22.7	...	5.3
6–6.4	...	9.8	9.3	9.5	3.2	...	4.3	7.7	3.4	42.8	15.9	30.0	9.3
6.5–7.0	18.2	31.6	18.5	9.5	3.2	21.1	8.6	...	6.8	28.6	27.3	26.6	15.4
7.0+	81.8	48.8	70.4	76.2	84.8	78.9	87.1	87.2	84.4	21.5	34.1	43.4	70.0
	Number of Determinations												
Plasma albumin (gm./100 ml.)	12	48	71	21	32	36	67	40	55	15	44	...	441
	Per Cent Distribution												
<3.0	...	8.3	9.8	19.0	9.4	11.1	1.5	7.5	12.7	...	13.6	...	8.8
3.0–3.9	58.4	56.2	54.8	42.7	75.0	52.7	17.9	22.5	41.7	60.0	63.6	...	46.4
4.0–5.0	41.6	35.5	35.4	38.3	15.6	36.2	55.2	50.0	45.6	40.0	22.8	...	39.0
5.1+	...	...	...	...	...	...	25.4	20.0	...	...	...	...	5.8
	Number of Determinations												
Hemoglobin (gm./100 ml.)	11	19	34	19	31	26	60	31	54	14	35	22	356
	Per Cent Distribution												
<10	...	5.3	...	...	...	...	1.7	3.2	14.8	...	...	4.5	3.4
10.0–10.9	...	5.3	...	5.3	...	7.7	8.3	9.7	1.9	...	...	...	3.6
11.0–11.9	...	10.5	5.9	5.3	9.7	3.8	5.0	6.5	7.4	...	5.7	...	5.6
12.0–13.9	...	10.5	23.5	15.8	25.8	30.8	33.3	29.0	22.2	71.4	25.3	36.4	27.2
14.0–14.9	18.2	5.3	32.4	26.4	12.9	34.6	20.0	9.7	18.5	14.3	4.4	27.2	19.4
15.0+	81.8	63.1	38.2	47.2	51.6	23.1	31.7	41.9	35.2	14.3	57.2	31.9	40.8
	Number of Determinations												
Mean cell hemoglobin concentration	12	18	31	19	31	26	60	31	38	14	35	20	335
	Per Cent Distribution												
<28	...	5.6	...	...	...	...	1.7	...	18.4	...	...	...	2.7
28.0–29.9	...	11.1	...	...	3.2	...	1.7	...	2.6	...	2.9	5.0	2.1
30.0–33.9	16.6	16.6	6.5	26.3	29.1	23.1	33.3	41.9	26.3	21.4	17.1	10.0	24.2
34.0+	83.4	66.7	93.5	73.7	67.7	76.9	63.3	58.1	52.7	78.6	80.0	85.0	71.0
	Number of Determinations												
Plasma vitamin C (mg./100 ml.)	12	40	53	20	34	38	64	39	56	11	33	10	410
	Per Cent Distribution												
<0.10	16.7	2.5	1.9	10.0	14.7	2.6	3.1	...	7.1	9.1	3.0	...	4.9
0.10–0.19	...	2.5	1.9	5.0	11.8	2.6	...	2.6	5.3	...	3.0	...	3.2
0.20–0.39	25.0	5.0	7.5	5.0	5.9	13.2	1.6	18.0	8.9	27.3	15.2	...	9.3
0.40+	58.3	90.0	88.7	80.0	67.6	81.6	95.3	79.4	78.7	63.6	78.8	100.0	82.6

* Table I shows the identification of locations.

TABLE XVI (*Continued*)

	Location												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total or Average
	Number of Determinations												
Plasma vitamin A (μg./100 ml.)	...	28	33	21	30	12	63	35	50	...	15	...	287
	Per Cent Distribution												
<10	...	...	3.0	...	...	...	...	...	...	...	...	...	0.3
10–19	...	21.4	6.1	19.0	13.3	...	1.6	5.7	2.0	...	...	...	7.0
20–49	...	57.2	63.6	57.2	66.7	75.0	44.4	60.0	58.0	...	93.3	...	59.3
50+	...	21.4	27.3	23.8	20.0	25.0	54.0	34.3	40.0	...	6.7	...	33.4
	Number of Determinations												
Plasma carotene (μg./100 ml.)	...	29	52	21	32	38	70	39	56	...	14	...	351
	Per Cent Distribution												
<20	...	...	...	...	...	...	...	...	...	...	...	...	0.0
20–39	...	...	1.9	4.8	3.1	...	1.4	...	5.4	...	...	...	2.0
40–99	...	31.0	25.0	23.8	34.4	18.4	5.7	25.6	42.8	...	21.4	...	24.5
100+	...	69.0	73.1	71.4	62.5	81.6	92.9	74.4	51.8	...	78.6	...	73.5
	Number of Determinations												
Urinary thiamine (μg./gm. creatinine)	20	41	57	19	38	32	63	42	59	14	29	27	441
	Per Cent Distribution												
<27	20.0	17.1	7.0	...	...	...	...	14.3	27.2	...	6.9	7.4	9.3
27–65	55.0	19.5	22.8	10.5	5.3	18.8	6.4	21.4	32.2	...	31.0	18.4	20.0
66–130	10.0	22.0	28.1	36.9	26.3	43.7	20.6	33.3	20.3	...	20.7	37.1	25.6
130+	15.0	41.4	42.1	52.6	68.4	37.5	73.0	31.0	20.3	100.0	41.4	37.1	45.1
	Number of Determinations												
Urinary riboflavin (μg./gm. creatinine)	20	42	57	21	37	37	67	37	58	14	35	26	451
	Per Cent Distribution												
<27	...	...	...	...	...	...	...	...	...	...	...	7.7	0.4
27–79	10.0	2.4	...	...	...	...	...	...	...	...	...	7.7	1.1
80–270	70.0	23.8	40.3	28.6	16.2	21.6	13.4	56.8	39.7	...	28.6	46.2	31.5
270+	20.0	73.8	59.7	71.4	83.8	78.4	86.6	43.2	60.3	100.0	71.4	38.4	67.0
	Number of Determinations												
Urinary N′-methyl nicotinamide (mg./gm. creatinine)	20	43	58	19	38	39	65	36	60	14	35	26	453
	Per Cent Distribution												
<0.5	...	...	1.7	...	...	...	...	2.8	11.7	...	...	...	2.0
0.5–1.59	5.0	25.6	19.0	21.1	7.9	2.6	23.1	36.1	13.3	...	14.3	11.5	16.6
1.6–4.3	70.0	55.7	55.2	57.8	42.1	59.0	50.8	36.1	55.0	21.4	45.7	57.6	51.4
4.3+	25.0	18.7	24.1	21.1	50.0	38.4	26.1	25.0	20.0	78.6	40.0	30.9	30.0

TABLE XVII
Hemoglobin Levels in Females

Range of Values (gm./100 ml.)	Non-Pregnant				Pregnant	
	All Ages		Older Than 18 Yr.			
	No.	%	No.	%	No.	%
<10	6	3.4	6	4.8	2	7.4
10.0–10.9	7	3.9	5	4.0	4	14.8
11.0–11.9	10	5.6	10	8.0	3	11.2
12.0–13.9	65	36.2	44	35.2	10	37.0
14.0–14.9	42	23.5	30	24.0	4	14.8
15+	49	27.4	30	24.0	4	14.8
Total	179	100.0	125	100.0	27	100.0

NOTE: Per cent with hemoglobin <12.0 gm./100 ml.: non-pregnant, all ages, 12.9; non-pregnant, older than 18 years, 16.8; pregnant, 33.3.

Both thick and thin blood smears were examined for the presence of malaria parasites.

Mean cell hemoglobin concentration (M.C.H.C) was calculated from hematocrit readings as follows:

$$\frac{\text{gm. hemoglobin per 100 ml. of blood}}{\text{volume of packed cells, ml. per 100 ml. of blood}} \times 100 = \text{M.C.H.C.}$$

Table XIII summarizes the biochemical evidence of potential nutritional problems. Shown here are the percentages of the total sample in the two lower ranges used by the ICNND, called "deficiency" and "low." This grouping was examined in order to reveal the portion of the population that was on a marginal plane of nutrition, and therefore most susceptible to suffering frank deficiency in the event of crop failure or an economic crisis. Total protein, albumin, thiamine and niacin are most striking here with incidences greater than 15 per cent. Ascorbic acid and vitamin A, however, also appear to pose a potential threat with incidences greater than 5 per cent. The frequency of low hemoglobin merits attention in this same regard.

Tables XIV to XVIII present the detailed biochemical findings.

CLINICAL STUDIES*

During twenty-four days in June 1958, four physician members of the survey team performed standard physical examinations on 3,113 Haitians. Tables I and XIX give the locations and distribution of the population studied. There was no attempt to select representative samples of communities, schools, or dispensary patients. Presence in the dispensaries or schoolrooms was the determining factor for inclusion of all subjects. The data concerning personal identity, age, height and weight were recorded by two Haitian nurses. Blood and urine specimens were obtained by a Haitian physician and nurse from almost 15 per cent of the subjects in the study.

Body Weight

The deviations in weight from American and British standards are presented in Table XX. The standards employed were as follows:

(1) For males twenty to thirty years old, the tables in the Manual published by the Interdepartmental Committee of Nutrition for National Defense.

(2) For older males and for females over

* The clinical examinations were performed by W. H. Sebrell, Jr., E. L. Severinghaus, J. Bernadotte, H. Delva and W. Fougere.

TABLE XVIII
Malaria Incidence (By Locations)

Location	No. Samples	No. Positive	% Positive
Port-au-Prince Hospital	28	0	0
La Saline	12	0	0
Guilloux School	10	0	0
Venezuela School	12	0	0
Petionville Center	15	0	0
Petionville School	18	0	0
Orphanages P.A.P.	12	0	0
Carrefour Center	14	0	0
Carrefour School	17	0	0
Kenscoff Center	13	0	0
Kenscoff School	10	0	0
Mirebalais Center	19	1*	5.3
La Boule	20	0	0
Croix-des-Bouquets	15	1†	6.7
Furcy	23	1†	4.4
Schweitzer Hospital (Deschapelles)	41	3†	7.3
Gonaives	22	1†	4.6
Pont de l'Estere	20	0	0
Gros Morne	18	7†	38.8
Cap Haitien Hospital	20	1	5.0
Limbe	20	1†	5.0
Limonade	22	3†	13.6
St. Raphael	18	1†	5.6
Cap Haitien Center	20	0	0
Trou du Nord	29	0	0
Totals	468	20	4.3

* Quartan. † Falciparum.

TABLE XIX
Composition of Sample*

Ages (yr.)	Sex	
	Male	Female
5–9	252	231
10–19	535	727
20–29	202	400
30–39	119	281
40–49	68	146
50–59	58	64
60–69	31	37
70–79	5	13
80–89	2	2
90–99	1	0
Totals	1,273	1,901
Rural	720	1159
Urban	553	742

NOTE: Of those aged 5 to 19 years, 699 males and 786 females were in schools.

* This tabulation includes 61 persons, records from which were deleted from final study because of incompleteness or suspected errors.

the age of eighteen, Tables A and B from "Body Weight at Different Ages and Heights," by W. F. F. Kemsley, *Annals of Eugenics*, 16, part 4, pp. 316–334, 1952. (British data on 61,077 persons examined in 1943.)

(3) For males five to nineteen years old, and for females five to eighteen years old, the Baldwin-Wood Tables 36 and 37 in "Heights and Weights of Children in the United States," *Home Economics Research Report No. 2*, U. S. Department of Agriculture, October, 1957.

It is apparent that the most common finding is weight 80 to 90 per cent of standard, but that 90 to 100 per cent is almost as common. Obesity, i.e., weight more than 10 per cent above standard, was almost as uncommon as striking leanness, i.e., more than 30 per cent below standard. One might observe that 83 percent of the entire group weighed less than the standards used, and more than 51 per cent were below 90 per cent of standard.

Notable for deviation from this pattern are the populations in locations II, X, XI and XII. These are obviously the economically more favorable communities and schools of children from better homes, or in a well managed home for orphans. It is, therefore, not surprising to find the weight values in higher brackets in these four locations.

Only three emaciated or cachectic persons were recorded in the total sample.

Skinfold Thickness

Examination of Table XXI shows that the skinfold thickness on the arm tends to increase in the second decade. There is little progressive increase during the third and fourth decades. The frequency of low values diminishes progressively during this span of forty years. However, after forty there is an abrupt

TABLE XX
Geographic Distribution of Body Weight

Location	No. Examined	% of Standard Body Weight					
		70	70–79	80–89	90–99	100–109	110+
I	151	4.1	17.3	44.8	21.4	7.2	5.2
II	297	1.0	6.1	32.5	35.2	18.8	6.4
III	361	2.8	13.6	38.2	29.8	12.4	3.2
IV	132	3.6	6.8	37.2	34.0	15.2	3.2
V	229	3.6	20.6	43.2	24.2	6.6	1.8
VI	309	3.2	16.5	42.1	26.5	9.1	2.6
VII	354	3.7	16.4	43.0	27.5	8.3	1.1
VIII	189	0.9	20.7	30.7	32.9	10.0	4.8
IX	325	3.4	12.9	33.6	25.5	14.4	10.2
X	99	1.0	6.0	34.4	42.4	15.2	1.0
XI	382	0.3	2.9	36.4	43.7	14.9	1.8
XII	285	1.0	6.0	31.6	33.6	20.8	7.0
Total	3,113	2.3*	11.9	37.1	31.7	13.0	4.0

Note: Values are the per cent of sample at each location.
* This and numbers to right represent averages.

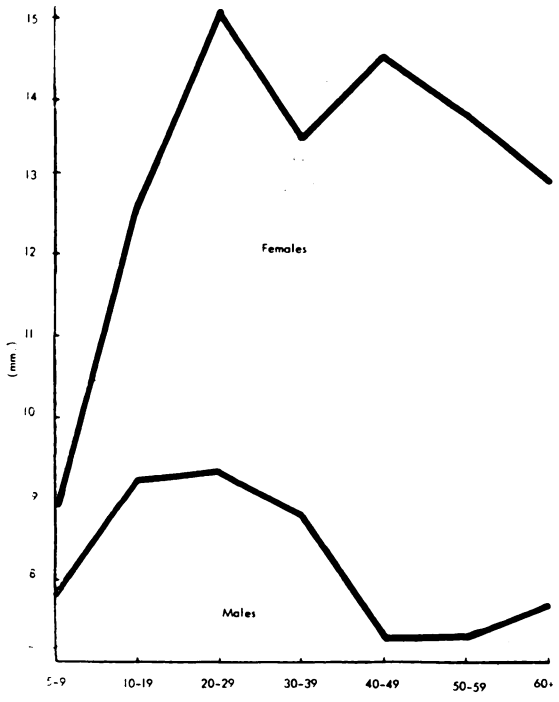

FIG. 1. Change of skinfold thickness on arm with age (medians). Abscissae—Age in years.

but sustained decrease in the skinfold thickness in males. This is manifested by a larger proportion of measurements below 5 mm., fewer above 10 mm., and the absence of observations above 15 mm.

The data on females follow a similar course in part, but with the following exceptions: (1) Preadolescent values are slightly larger. (2) During the second decade the increased subcutaneous fat layers are more apparent in the females than in the males. (3) Third decade measurements show a progressive increase in fat. (4) Regression to less arm fat is not shown until the seventh decade.

In Figure 1 these data are condensed graphically. The median for males remains below 10 mm., and only seven measurements were as great as 20 mm. The median for females is between 12 and 15 mm. after the age of nine. Measurements of 20 mm. or more were recorded in 12.7 per cent of all females, of 25 mm. or more in 4.9 per cent, and of 30 mm. or more in 1.6 per cent.

It was hoped that observations on skinfold thickness might provide a better criterion for obesity than per cent deviation from weight predicted by actuarial standards based on North American or British data, applied to a different racial group in a different cultural environment. Our data are presented in Table XXII for such correlations. The

TABLE XXI

Skinfold Thickness by Age and Sex

Skinfold (mm.)	Age (yr.)										
	5–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89	90+	Totals
1,268 Males											
1–4	12.7	6.0	3.9	1.7	23.9	22.4	32.2	20	50	0	115
5–9	66.8	52.0	55.0	64.0	56.9	60.3	38.8	20	50	0	721
10–14	19.1	36.3	33.6	29.3	19.2	17.3	29.0	20	0	100	377
15–19	0.8	5.1	5.5	5.0	0	0	0	40	0	0	48
20+	0	0.6	2.0	0	0	0	0	0	0	0	7
1,894 Females											
1–4	7.8	0.5	0.5	1.4	2.7	0	11.1	0	0	0	36
5–9	54.1	27.8	12.1	21.0	19.2	20.3	19.4	23.0	0	0	484
10–14	32.5	41.3	37.5	38.5	32.2	40.6	38.8	38.5	50	0	725
15–19	4.7	23.5	30.6	21.0	19.8	15.6	14.0	30.8	0	0	408
20–24	0.9	5.9	12.9	10.0	15.8	11.0	11.1	0	50	0	159
25–29	0	0.9	5.1	3.5	5.5	7.8	2.8	0	0	0	51
30–34	0	0.1	0.8	3.5	3.4	4.7	0	7.7	0	0	23
35–39	0	0	0	0.7	0.7	0	0	0	0	0	3
40+	0	0	0	0.5	0.4	0.7	0	2.8	0	0	5

NOTE: Values are the % of sample in each age group.

TABLE XXII

Skinfold Thickness as Related to Standard Weight

Skinfold (mm.)	% of Standard Weight										
	60–69	70–79	80–89	90–99	100–109	110–119	120–129	130–139	140–149	150+	Totals
1,268 Males											
1–4	12	24	53	22	4	0	0	0	0	0	115
5–9	4	97	327	236	47	8	1	0	0	1	721
10–14	1	22	132	161	55	4	1	1	0	0	377
15–19	1	1	12	17	14	1	2	0	0	0	48
20+	0	0	1	3	2	1	0	0	0	0	7
1,894 Females											
1–4	7	10	11	3	1	1	0	0	2	1	36
5–9	15	104	222	106	26	7	0	0	0	4	484
10–14	19	98	279	226	100	9	1	0	0	2	725
15–19	4	18	109	164	88	17	4	2	1	0	408
20–24	0	4	24	54	49	21	4	2	1	1	159
25–29	0	0	0	10	19	15	5	2	0	0	51
30–34	1	0	2	3	4	2	7	1	3	0	23
35–39	0	0	0	0	0	0	0	2	0	1	3
40+	1	0	0	0	0	0	2	1	1	0	5

NOTE: Values are number of individuals.

TABLE
Stature Distribution

Age (yr.)	Stature in																		
	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
5				1		5	3	2	2	2	2	2	1		1					
6	1	1	1			3	4	6	2	5	9	6	12	10	7	9	1	2	1	
7					1		4	1	3	1	5	6	8	10	5	7	2	1		
8								1	1	2	3	4	4	7	3	4	10	3	1	2
9												2	3	7	9	4	9	8	6	3
10													2	1	4	15	11	16	13	13
11															2	3	6	9	9	11
12															3	2	4	5	9	12
13																		1	2	
14																				2
15																				
16																				
17																				
18																				
19																				
20–29																				
30+																				

NOTE: Values are number of persons.

male group does show more individuals with less than 5 mm. skinfold thickness in those with weights less than 100 per cent of predictions. There is, however, no progression toward thinner arms below the 80 per cent group. The slight trend toward progressive increase in frequency of skinfold measurements from 15 mm. up seen with increasing relative weights is probably not a useful criterion. This increase begins to appear in the 80 to 89 per cent weight group, but the number of persons with this characteristic is too small above 110 per cent relative weight to provide any assurance in use of such skinfold data beyond mere confirmation of the height-weight-age-sex classifications. There may be a "break-point" in male skinfold thickness which provides a criterion for obesity, superior to conventional methods, but we cannot identify such a figure from our data.

The comparisons of skinfold measurements with weight in females are not apparently too helpful, for similar reasons. The trends toward little fat in the arms of females as weight decreases below 100 per cent and to skinfold thickness of 20 mm. or more as weights go upward from 80 per cent are more obvious than the parallels in males. Search for a "break-point" indicative of obesity is unrewarding in two ways: employing 30 mm. as such a point would identify as obese seven who are below the 100 per cent weight level (not theoretically impossible) but it would also fail to identify thirty-two who are more than 20 per cent overweight.

In Figure 2 are seen the medians of per cent

XXIII
of Males by Age

Inches																				
54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
	1																			
11	9	3	3		1	1	1													
12	8	10	7	9	1	2														
8	8	4	15	9	13	1	3	2	1											
6	8	12	7	9	10	3	4	2		1	1									
2	3	2	2	2	5	8	2	4	5			1		2						
	1		4	2	2	4	3	5	1	6	1	3	3	3						
			1		3	2	1	5	5	4	3	4		1						
						3	3	5	2	5	5	3	1	3						
						1	1	2	3		5	1	7		1					
							1	2	3		1	2	5		2	2			1	
						4	5	12	16	18	21	32	32	26	18	8	66	3	1	
				3		4	3	12	22	23	31	43	35	36	31	21	13	6		1

weight deviation plotted against arm skinfold thickness, together with the lines representing first and third quartiles. Although the continuous progression of values is fairly regular and strikingly similar for the sexes, the wide divergences between medians and quartiles suggests limited authenticity for any prediction of relative weight from the measurement of arm skinfold thickness.

We conclude that the use of skinfold thickness measurement must be carried forward by other means of tabulation and correlation before it can become a substitute for relative weight as a criterion of obesity.

The measurement of skinfold thickness with standardized calipers confirmed these observations by showing uncommonly an appreciable amount of subcutaneous fat in the arm or subscapular areas. The Haitian population can be characterized as slender, muscular, and of a strikingly wide variety of stature.

Stature

The distribution of statures by ages is shown in Tables XXIII and XXIV. The extensive scatter of values at a given age is apparent. A graphic representation of the medians and first and ninth deciles is given in Figures 3 and 4. The striking frequency of very short children and adults may be stressed.

PHYSICAL FINDINGS

In Table XXV are presented the occurrence (in per cents) of various physical findings for the 3,113 subjects, of which 1,800 were female.

The frequency of palpable enlargement of

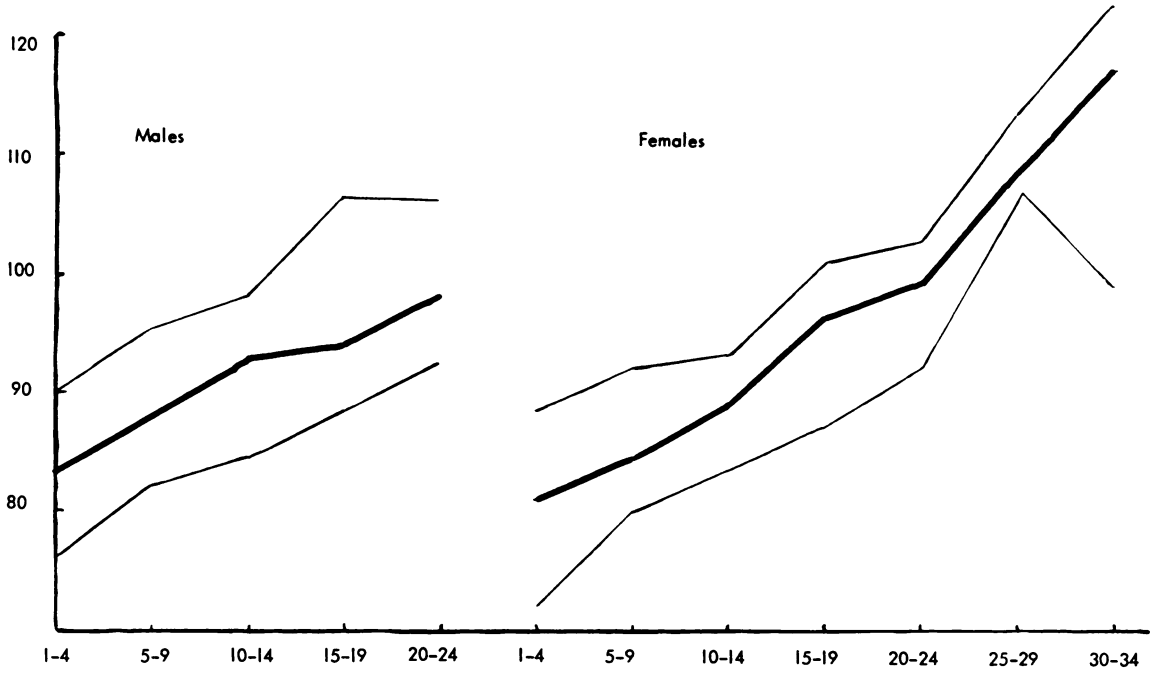

FIG. 2. Prediction of per cent weight deviation from standard by arm skinfold thickness. Medians with first and third quartiles. Abscissae—mm. skinfold. Ordinates—per cent of standard weight.

thyroids, greater in females in Haiti than elsewhere, was surprising. The figures range from 17.5 to 39 per cent for all females, omitting only the girls in the orphans' home, most of whom were under fifteen years of age. Among males the figures vary from 1.4 to 16 per cent. The goiters were rarely obvious on inspection. General use is made of poorly refined sea salt. One sample of this salt was analyzed, showing only a trace of iodine. However, this salt undergoes much exposure to sun and air prior to use, and the iodine is probably lost during this interval.

Enlarged parotid glands were frequently obvious on inspection as well as palpation. This was uniformly far more striking in males.

Impressively high frequency is recorded for follicular keratosis of skin (10 to 31 per cent), crackled skin (21 to 83 per cent), and for thickened conjunctivas (9 to 81 per cent) and pingueculas. Bitot's spots were seen in many cases (5 per cent). Whereas all these signs suggest a long standing deficient supply of vitamin A, we were also impressed with the factor of exposure to dirt and weather. These findings were minimal in younger subjects. Crackled skin on legs occurred less severely and less frequently in the urban groups with better clothing and less contact with soil and less trauma to legs. It would be difficult to escape the impression of frequent suboptimal intake of vitamin A.

Correlations between eye and skin lesions and blood levels of carotene or of vitamin A are shown in Table XXVI. No satisfaction is obtained by attempts to correlate vitamin levels with the data concerning thickened conjunctivas or pingueculas. Bitot's spots tend to be less frequent as higher levels of carotene or of vitamin A are found. Follicular keratosis varies inversely with vitamin A levels, less so with carotene. However, these lesions might be expected to disappear with the higher levels of vitamin A. The poor correlations suggest that the lesions signal prolonged deficiencies, the blood levels more recent adequacy of vitamin or carotene intake.

Nasolabial seborrhea (0 to 34 per cent) and the lip angular lesions (0 to 47 per cent) and scars (3 to 55 per cent), as well as cheilosis (2.3 to 29 per cent) called attention to the frequent occurrence of continued periods when

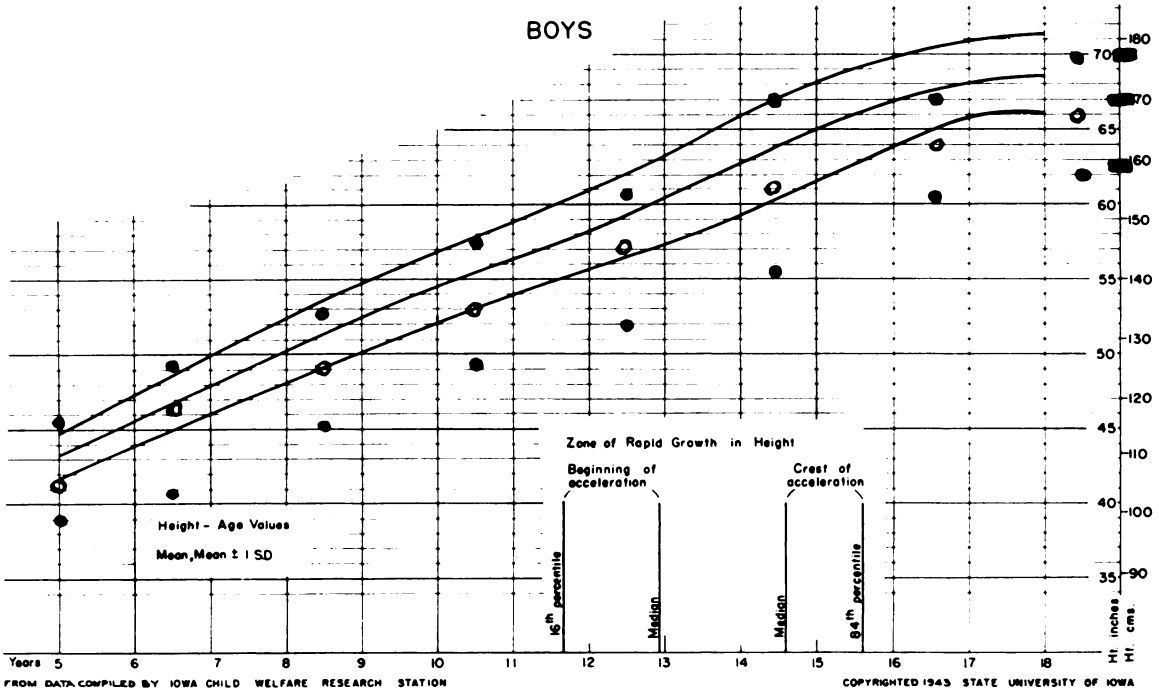

FIG. 3. Stature of males in Haiti, compared to Iowa standards. Open circles are means, solid circles are first and ninth deciles. Solid bars at right are adult statures.

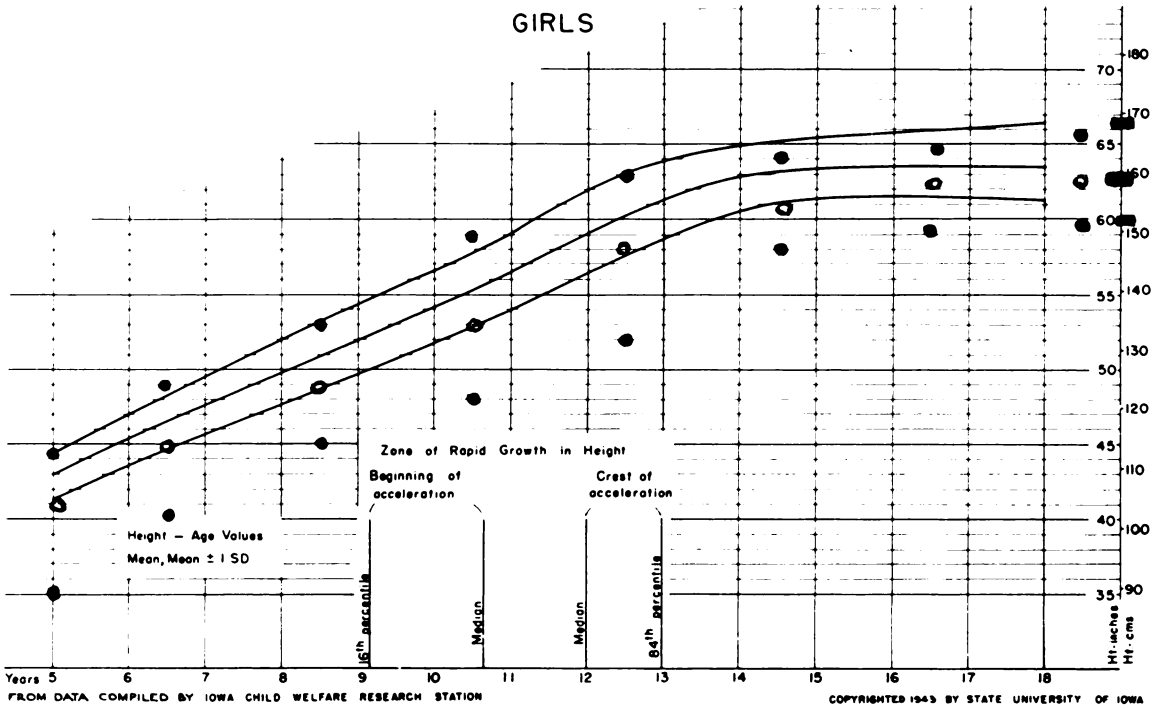

FIG. 4. Stature of females in Haiti, compared to Iowa standards. Open circles are means, solid circles are first and ninth deciles. Solid bars at right are adult statures.

TABLE
Stature Distribution

Age (yr.)	Stature in																			
	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
5	30-1 33-1	1	1		2	4	3	2	2	5	4	1								
6		1		3	1	2	2	2	6	10	3	2	2	1	1	1	1			
7						1		2	2	6	7	9	9	11	7	4	1	3		
8								1	1	3	1	8	2	8	10	10	7	1	3	
9											3	1	1	7	5	5	4	6	5	4
10										1		1	2	5	6	7	15	11	9	13
11														1	2	4	5	7	15	9
12		1											1	1		3	1	4	5	11
13																			2	
14																				
15																				
16																				
17																				
18																				
19																				
20+																				

NOTE: Values are number of persons.

riboflavin intake must have been low. In the entire population studied 51.5 per cent showed one or more of the three lesions of the lip mentioned. Nasolabial seborrhea was observed in 17.5 per cent of all persons examined. The frequency of these three lesions of the lip in the seborrheic group was 68.7 per cent. The frequency of any one of these four findings varied rather widely. At some stations almost every person showed at least one of the signs. Obviously angular scars are attributable to former open lesions, now healed. But angular moist lesions, cheilosis and seborrhea lead to suspicion of recent deficiency.

No correlation could be established between low urinary riboflavin levels and angular lip lesions or scars, cheilosis or seborrheic dermatitis. The urinary riboflavin levels were at least "acceptable" in 98.5 per cent of specimens analyzed. The dietary studies made simultaneously by other members of the survey team provide a probable explanation. In a country in which little milk is available, and in which most people have little intake of meat or eggs, the riboflavin supply is contributed by mangoes and avocados as much as by all other sources combined. The survey was conducted in June just as mangoes and avocados were

XXIV
of Females by Age

Inches

54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
1																				
1	1		1																	
11	7	5	3	1		1														
14	13	14	7	4	4	2	1	1												
8	12	10	15	13	9	9	7	3												
1	6	7	9	17	17	16	6	4	7	2										
	1	2	9	6	4	12	16	16	11	9	1	1								
		1	2	6	11	12	11	17	3	10	1	1								
		2	1		2	12	3	12	10	6	3	4	1		1					
		2		2	3	4	6	2	3	4	3									
		1		2	4	10	6	5	7	5	4	2		1	1					
			1			1	3	2	2	5	3				1					
1		4	18	27	54	122	119	132	130	112	97	58	38	12	6	4	2	5	*	1

becoming seasonally available. It may well be that this was the end of a period of several months of annual riboflavin depletion, marked by lesions at the same time that repletion with riboflavin led to good urinary levels of the vitamin.

Similar comments may be applied to the frequent disorders of lingual papillae, redness of the tip of the tongue (5.6 to 50 per cent) and the visible furrows (1.1 to 55 per cent) in the body of the tongue. Whether these lesions are referable to deficiencies of riboflavin, niacin or other members of the vitamin B group need not be discussed. We made frequent inquiries in dispensaries and hospitals for cases of pellagra, but found only one child who probably was convalescing from acute pellagra. (Confusion of pellagra with kwashiorkor is still a problem in Haiti, as elsewhere.)

Impressive also is the common occurrence of swollen, red gum margins (18.5 to 53 per cent) at all ages and in all locations. Except in children the atrophy (5.6 to 43.5 per cent) and recession (4.2 to 49.7 per cent) of dental papillae also showed chronicity of these lesions. Bleeding or scorbutic gums were observed in 3 per cent of the total group examined. Since an additional 1.5 per cent were edentulous and

TABLE
Physical Findings (Incidence in % of

Physical Findings	Location							
	I		II		III		IV	
	Male (72)	Female (79)	Male (99)	Female (198)	Male (121)	Female (240)	Male (80)	Female (52)
General appearance:								
Fair–good	94.4	96.3	96.0	95.4	92.5	95.0	100.0	94.0
Poor	5.6	3.7	4.0	4.6	7.5	5.0	...	4.0
Cachectic	...	...	...	...	...	...	...	2.0
Thyroid enlarged	1.4	21.5	5.0	33.8	5.8	17.5	16.3	25.0
Parotids enlarged	27.8	6.4	10.0	4.6	13.2	7.5	15.0	9.6
Nasolabial seborrhea	...	6.4	7.1	10.0	23.2	24.2	16.3	9.6
Follicular keratosis	22.2	21.5	17.0	17.2	28.9	15.8	10.0	17.4
Crackled skin	22.2	36.8	63.0	68.2	39.6	48.0	73.5	83.0
Thickened conjunctivas	66.8	63.4	54.0	60.4	33.0	57.0	68.8	81.0
Pingueculas	21.0	24.0	10.0	11.0	21.5	16.5	20.0	30.0
Bitot's spots	1.4	1.3	4.0	6.0	10.7	7.9	6.7	4.0
Lips:								
Angular lesions	7.0	...	9.0	3.0	23.9	18.8	16.3	22.0
Angular scars	3.0	15.0	27.0	29.0	43.0	33.3	3.0	34.8
Cheilosis	2.8	2.5	11.0	11.5	23.9	16.7	8.7	17.4
Filiform atrophy	4.2	1.3	5.0	5.5	9.1	8.7	6.7	16.0
Papillary hypertrophy	23.3	30.4	42.0	38.4	31.4	38.7	20.0	34.8
Tongue:								
Furrows	14.0	20.2	33.0	22.0	38.8	32.5	55.0	38.5
Red tip	5.6	13.0	40.0	31.5	42.0	34.6	50.0	34.8
Glossitis	...	1.3	1.0	1.0	1.6	...	1.25	4.0
Magenta color	1.4	1.3	4.0	1.5	5.0	5.4	7.5	7.8
Red or swollen	27.9	34.2	53.0	36.8	39.7	28.7	32.5	43.0
Atrophy of papillae	5.6	19.0	23.0	24.2	25.0	18.3	35.0	40.5
Gums:								
Recession	4.2	22.8	25.0	22.7	29.8	20.8	42.5	43.0
Bleeding	...	2.5	2.0	1.5	0.8	1.7	...	4.0
Scorbutic type	...	...	...	1.0	...	...	1.25	4.0
Dental caries	41.7	60.8	45.0	61.2	62.0	51.3	67.5	71.0
Bilateral edema	1.4	...	...	2.2	0.8	...	...	5.8

NOTE: Figures in parentheses represent number of persons examined.

far more had many missing incisor teeth, the gravity of gingival disease in the Haitian population is apparent. Attempts to find correlations between frequencies of gum lesions and low levels of blood vitamin C were entirely unrewarding. There were numerous cases of obvious gingival edema, redness, atrophy and even a few with easy bleeding in individuals whose plasma ascorbic acid was above 1.2 mg. per 100 ml. Similarly it was common to find low plasma ascorbic acid values without gingival lesions. "Deficient" and "low" plasma ascorbic acid values were found in only 8.1 per cent of 410 analyses. The great daily as well as seasonal fluctuations in ascorbic acid intake are probably responsible for the failure to find correlations. The diet study showed a per capita intake of ascorbic acid of over 300 mg. daily. This depended upon mangoes for 200 mg. and leaves and vegetables for 50 mg. These sources are highly seasonal and general availability had begun very shortly before the survey occurred. The coincidence of lesions caused by long continued deficiency of ascorbic acid and of blood levels of vitamin C within the accepted normal limits is similar to the

XXV
Sample Examined)

Location													
V		VI		VII		VIII		IX		X		XI	XII
Male (139)	Female (90)	Male (65)	Female (244)	Male (189)	Female (165)	Male (76)	Female (113)	Male (79)	Female (246)	Male (11)	Female (88)	Male (382)	Female (285)
87.0	93.3	94.0	97.0	91.0	95.0	93.5	92.0	95.0	95.0	63.6	87.5	97.4	98.7
13.0	6.7	4.5	3.0	9.0	5.0	6.5	8.0	5.0	4.5	36.4	12.5	2.6	1.3
...	...	1.5	...	...	...	...	...	...	0.5	...	...	...	...
15.2	39.0	9.3	27.0	13.7	28.5	15.8	24.8	6.3	31.7	...	6.7	8.4	17.9
20.8	10.0	13.8	8.2	21.3	15.8	22.4	6.2	14.0	4.5	...	1.1	6.0	6.3
23.0	20.0	23.1	29.6	29.0	28.5	34.2	30.5	19.0	13.0	...	...	5.5	9.1
19.4	16.7	24.8	21.2	24.8	18.2	31.6	17.7	21.5	14.6	...	10.2	18.1	24.2
64.5	60.0	23.1	30.7	47.0	53.3	21.1	38.0	30.4	48.5	63.6	52.3	34.0	52.0
68.5	73.5	69.2	51.2	67.8	65.0	72.3	55.7	82.0	52.5	9.1	14.8	45.8	56.0
15.2	23.4	20.0	10.6	19.5	16.9	36.8	22.0	24.1	27.6	...	...	3.1	0.3
1.5	5.6	7.7	3.7	5.8	6.7	10.5	4.4	13.9	12.6	...	...	0.5	0.3
40.3	37.0	40.0	20.4	47.5	44.8	34.2	21.5	11.8	17.5	...	...	0.5	2.5
41.0	37.8	18.5	34.7	30.1	29.7	35.5	42.5	48.0	44.4	55.0	20.4	14.4	10.2
21.6	28.9	17.0	11.9	19.5	15.7	19.8	15.0	3.8	13.0	9.1	2.3	3.4	8.4
33.0	26.6	26.2	15.1	29.0	20.0	26.3	21.2	17.7	17.1	27.3	3.4	3.9	3.2
21.6	24.5	15.4	25.0	25.4	24.2	13.2	26.6	26.6	32.9	36.6	68.3	28.4	40.3
38.8	45.5	26.2	21.3	29.6	32.2	51.5	39.8	32.9	48.5	...	1.1	8.7	5.3
41.0	36.7	35.4	33.6	34.4	29.7	37.8	31.0	36.7	35.4	27.3	17.1	11.5	24.6
...	1.1	1.6	2.5	2.6	...	1.3	...	3.8	2.0	...	...	0.5	1.0
2.9	3.3	6.2	...	2.6	2.4	1.3	2.6	1.3	0.8	...	...	0.3	0.3
49.5	43.5	18.5	26.6	43.7	44.3	39.5	41.7	35.4	35.4	27.3	42.0	35.4	30.6
32.4	33.3	29.3	13.8	16.4	20.7	43.5	28.3	40.5	22.0	...	...	4.4	2.1
41.7	37.9	37.0	15.3	28.0	31.5	49.7	38.0	46.8	24.2	...	4.6	3.4	4.6
2.2	4.5	...	1.25	3.2	1.8	1.3	4.4	2.5	2.0	...	...	0.3	0.3
3.6	5.5	...	1.6	6.9	0.6	1.3	2.7	25.0	4.5	...	...	...	...
59.0	65.5	43.0	36.0	39.5	43.7	64.5	46.8	55.8	57.0	63.6	22.8	32.5	28.1
2.1	...	1.7	2.1	0.5	1.2	13.1	5.3	2.5	1.6	...	...	...	...

TABLE XXVI
Per Cent Frequency of Physical Findings at Various Plasma Carotene and Vitamin A Levels

Finding	Carotene (%)			Vitamin A (%)		
	<40 Low	40–99 Acceptable	100–100+ High	<20 Low	20–49 Acceptable	50+ High
Thickened conjunctivas	71	85	69	68	68	82
Pingueculas	28	30	29	21	23	44
Bitot's spots	0	15	8.5	11	9	5
Follicular keratosis	0	19	17	32	18	16

observations on lips and riboflavin levels already referred to.

In a well conducted orphanage for girls it was observed that the incidence of red and swollen gums was distinctly higher (42 per cent) than that seen in a public school for girls of comparable ages (30.6 per cent). Direct inquiry at the orphanage revealed that fresh fruit had not been served the girls during a two-month interval because it was not understood that it was nutritionally important.

We do not attempt to interpret the caries data. Well developed teeth with conspicuously infrequent caries were repeatedly noted in children and youths. Whereas chewing sugar cane is common there is little use of candy, carbonated drinks and other confections. Sugar consumption is one-third that in the United States. The diet is, however, high in starchy foods.

Dental fillings were seen in only 2 per cent of our subjects.

Edema was noted in only forty-three persons, of which one-half were in three hospitals. Edema in our cases was not as frequent as might have been expected with a known low protein intake per capita.

The data on enlargement of liver and spleen and on ascites are not tabulated. The circumstances of the examinations made only gross changes detectable. Inquiry by the nurses who registered all subjects elicited a history of malaria in 28 per cent of persons. The direct examination of blood smears obtained from 450 persons was positive in 3.6 per cent. Inquiry about current presence of diarrhea brought affirmative replies in 4.6 per cent of all those examined.

Tenderness of the calf, never extreme, was encountered in only twelve instances. We think our data on the absence of ankle or knee reflexes misleading. On many occasions such absence was observed in adolescent subjects in whom we were certain there was no neurologic disturbance but that apprehension and tension interfered. Also, attempts to determine vibratory sense in the lower extremities were grossly handicapped by language barriers between Haitian subjects and the two American clinicians. In no cases were we even strongly suspicious of a polyneuritis suggesting thiamine deficiency.

TABLE XXVII
Stability of Cholesterol in Blood

Sample and Treatment	Plasma Cholesterol (mg. %)	
	Normocholesterolemic	Hypercholesterolemic
Control, frozen 13 days	67	282
Control, incubated 13 days	66	278
Inoculated, incubated 13 days	67	282

Evidence of former rickets was seen in three subjects. Rickets would not be expected where children with scanty clothing live so largely in the out-of-doors.

Of the several other physical signs observed, such as the quality of hair and depigmentation, the texture of skin or alterations in pigment, inflammatory lesions in eyes, detailed study of teeth, the observations were too confusing or too infrequently positive to merit tabulation and comment. No observations were made on blood pressure or pulse rate.

PLASMA CHOLESTEROL

Portions of blood samples collected in the field were transferred to tubes containing thymol and sodium fluoride. These were sent by air to Dr. David Tennent at the Merck Institute for Therapeutic Research, Rahway, New Jersey, to whom we are indebted for the cholesterol determinations.* In spite of the added preservative and efforts to keep the samples cold en route, most of the plasmas were obviously contaminated upon receipt in the laboratory. In order to determine the effect of the bacterial growth on the level of cholesterol, the following three experiments were conducted.

(I) A combined inoculum from two contaminated plasmas was added to samples of normocholesterolemic and hypercholesterolemic chicken plasma, which were then incubated at 37°C. for thirteen days and analyzed for

* We also wish to thank Mary Zanetti, David Johnson and Gunther Kuron for their technical assistance.

cholesterol with the following results (Table XXVII):

(II) With the thought that more destructive organisms might be found in plasma containing especially low cholesterol levels, three selected samples, selected because of low cholesterol values (83, 65, 68 mg./100 ml.), were used to inoculate portions of normocholesterolemic dog plasma. These were incubated at room temperature for five days and analyzed for cholesterol with the following results (Table XXVIII):

TABLE XXVIII
Stability of Cholesterol in Inoculated Plasma

Sample and Treatment	Plasma Cholesterol (mg. %)
Control, frozen 5 days	93
Control, incubated 5 days	97
Control, incubated with NaF and thymol, 5 days	96
Inoculated with Sample No. I	83
Inoculated with Sample No. II	95
Inoculated with Sample No. III	84

(III) Plasmas no. I and no. III were then plated, and two organisms were isolated in pure culture from sample no. I, and three organisms from sample no. III. These were used to inoculate sterile, hypercholesterolemic chicken serum, which was incubated at room temperature for four days and analyzed for cholesterol with the following results (Table XXIX):

The only significant decrease was observed with organism c from sample no. III (Table XXIX) in which the decrease was 18 per cent. However, this occurred with a pure culture from the original sample. The decrease observed on five days' incubation with sample no. III (Table XXVIII) showed a decrease of only about 12 per cent. Therefore, it was concluded that while contamination could lead to error and should be avoided, it was unlikely that its effect here was great enough to influence the interpretation of the results.

TABLE XXIX
Stability of Chicken Serum Cholesterol

Sample and Treatment	Cholesterol (mg./100 ml.)	% Change
Control, frozen 4 days	396	...
Control, incubated 4 days	395	...
Incubated, Sample No. I organism a	399	+0.75
Incubated, Sample No. I organism b	419	+5.5
Incubated, Sample No. III organism a	387	−2.3
Incubated, Sample No. III organism b	412	+4
Incubated, Sample No. III organism c	325	−18

The distribution of the plasma cholesterol values for males and females is given in Table XXX. It is of interest to note the relatively low values. The highest value in the entire sample was 218 mg./100 ml. In only 5 per cent of the males and 13 per cent of the females did values exceed 180 mg./100 ml.

TABLE XXX
Per Cent Distribution of Plasma Cholesterol Levels

Subjects	Cholesterol Levels (mg./100 ml.)				
	50–99	100–139	140–179	180–199	180–219
194 females	10	47	30	..	13
129 males	13	50	32	5	..

NOTE: Numbers are the per cent of sample in each group.

The serum cholesterol values are presented in greater detail in Table XXXI. The data fail to show any significant correlation with the occurrence of goiter, age and sex, or per cent of standard body weight. There is possibly a tendency for association between low serum cholesterol and low serum protein and serum albumin, similarly between higher levels of serum protein, serum albumin, and serum cholesterol.

SUMMARY

This survey of Haiti included appraisal of agricultural resources, food habits and vital statistics, as well as clinical examinations of more than 3,000 persons in a number of villages and cities. In addition, biochemical determinations were carried out on specimens of blood and urine from about 15 per cent of those undergoing physical examinations. Concur-

TABLE

Distribution of Serum Cholesterol Levels

Cholesterol Levels (mg./100 ml.)	No. Persons	No. with Goiter	% in Each Age Group				% of Standard		
			5–19	20–39	40–49	50+	<70	70–79	80–89
									194
50–99	19	2	37	53	5	5	5	11	21
100–119	40	10	28	50	18	5	3	23	35
120–139	52	12	33	52	10	6	4	12	33
140–159	31	9	42	45	10	3	..	10	29
160–179	27	8	11	52	22	15	..	19	22
180–199	13	1	54	31	8	8	..	23	31
200–219	12	5	58	25	17	..	..	17	17
									129
50–99	17	2	41	24	18	18	..	18	41
100–119	29	2	41	38	10	10	3	17	38
120–139	35	4	43	46	9	3	..	23	37
140–159	21	0	29	33	14	24	5	19	29
160–179	21	2	43	38	10	10	5	19	62
180–199	6	0	17	50	0	33	17	17	33

* In twenty-three instances of 323 cholesterol determinations, the serum protein or serum albumin determina-

rent with this study was a clinical appraisal of nutrition in infants and children up to five years of age, with similar geographic distribution, by Dr. and Mrs. D. B. Jelliffe.

A careful evaluation of all the information obtained indicates that the Haitian peasant suffers from multiple nutritional deficiencies. The most important of these appear to be insufficient calories and protein, as evidenced by underweight, poor muscular development, short stature and a high total serum protein with a relatively low serum albumin. Kwashiorkor, in all degrees of severity, was present in young children. There were some clinical suggestions of vitamin A deficiency which were further borne out by relatively low serum vitamin A levels, although serum carotene levels were high. A few cases of scorbutic gums and some gingival disease were found. A number of small goiters were seen, indicating a need for more iodine. There was considerable clinical evidence of widespread riboflavin deficiency but there was no correlation of these findings with low urinary riboflavin values. Serum cholesterol levels were low in keeping with the low fat, low protein diets. Moderate anemia was frequently noted. The data do not provide a basis for determining whether the deficiency was of iron, protein, or vitamins. Probably all are involved.

This survey showed that the Interdepartmental Committee technics are adaptable to a civilian population with the cooperation of the Health Department. The number of professional people required for this type of survey makes it expensive and difficult to organize. However, it is within the capabilities of a team of civilians with non-governmental support. The technics probably can be modified further in order to reduce the expense and still yield the necessary data. These technics, in our opinion, represent the best available method for appraising the nutritional problems of a country and furnishing the necessary collateral data on which a broad practical program for nutritional improvement can be based.

RECOMMENDATIONS

The principal needs in the Haitian diet are for more foods with better protein content,

XXXI

by Sex, Age, Weight and Serum Protein

Body Weight				Total Serum Protein*				Serum Albumin*			
90–99	100–109	110–119	120–149	5.0–5.8	5.9–6.9	7.0–8.0	>8.0	1.0–2.9	3.0–3.9	4.0–4.9	5.0–6.9
Females											
58	5	..	..	11	37	47	5	37	32	16	..
20	8	8	5	5	30	43	20	13	53	33	..
31	12	6	4	..	27	56	17	4	50	33	8
48	13	..	..	..	29	52	19	..	48	35	10
48	7	4	..	..	22	30	44	4	41	33	11
23	23	..	..	..	15	62	23	..	69	31	..
33	8	17	8	..	8	8	67	..	25	50	8
Males											
29	12	..	..	6	47	18	29	6	47	35	6
28	10	..	..	..	28	55	14	3	48	41	7
29	11	..	..	3	14	43	40	3	29	51	14
38	10	..	..	5	14	43	38	5	38	33	19
14	..	..	..	10	10	48	33	..	24	57	14
33	..	..	..	..	17	50	33	17	33	50	..

tions are not available. Therefore, in many cases, the figures for per cent as given total less than 100.

more fat or oil, and foods with improved riboflavin and vitamin A values. Increased intake of iron and iodine are important. It is our opinion that these needs can be met within Haiti's own resources. Seasonally recurring deficiencies of ascorbic acid and riboflavin are probable. A number of specific recommendations are made which may be, for convenience, classified as immediate measures and long-range plans.

Immediate Measures

1. Creation of a nutrition division in the Department of Public Health to work cooperatively with the Departments of Agriculture and Education. Through this nutrition division the following steps should be taken:

(a) Increase the distribution of UNICEF dried skim milk and vitamin A capsules through hospitals and medical dispensaries, especially to pregnant and lactating women, and to infants and children.

(b) Include more rural schools in the UNICEF dried skim milk and vitamin A distribution plan.

(c) Make dried skim milk available for the treatment of kwashiorkor and for all sick children in hospitals.

2. Iodate should be added to all salt.

3. Add riboflavin, niacin, thiamine and iron to all white wheat flour in accordance with the enrichment standards observed in the United States. This is inexpensive and materials and methods are readily available as a result of long experience in the United States.

4. Encourage the use of parboiled rice wherever rice is a staple of the diet.

5. Encourage the greater use of avocados.

6. Encourage the production of more chickens and eggs for home consumption.

7. Increase the availability and use of fish.

8. Encourage greater use of beans, peas, cashew nuts and peanuts as means for improving the intake of proteins.

Long-Range Plans

1. One of the most fundamental causes of malnutrition in Haiti is the small amount of food that the peasant is able to produce for his own use on the land available to him and by

using the inefficient agricultural methods. Ways must be found to increase the total amount of food available to the Haitian peasant family through improved agricultural practices and more efficient land use. Toward this end it is imperative that the program of soil conservation be strengthened. Furthermore, the Department of Agriculture, through the Extension Service, should play a vital role in bringing about improved crop yields by encouraging the use of fertilizers and insecticides, by introducing new crops and more productive strains of established crops. In cooperation with the Department of Education a program for the dissemination of information on the improvement of agricultural and dietary practices should be established.

2. It is difficult to teach new agricultural practices to the illiterate, even with the best efforts of the Extension Service. The program to combat illiteracy should be vigorously extended and should include the teaching of nutrition in its context. Public educational programs by means of radio, pictures, posters, etc. should be developed, which stress the health benefits of better nutrition.

3. Nutrition education should be included in the curricula of all rural and primary schools.

4. A vigorous program of increased livestock production should be undertaken.

5. The development of the Haitian fish and sea food industry should be supported.

6. The conservation and preservation for out-of-season use of vegetables and the abundant fruits of Haiti by canning, production of juice concentrates, jams and jellies, using the readily available sugar, should be encouraged.

7. Irrigation systems should be developed further and coordinated with those of the Artibonite Valley authority and the Department of Agriculture.

8. Population control studies should be inaugurated without delay. The rapid growth of the Haitian population (2 per cent annually) imposes an ever-increasing strain on the food resources. Studies should be started toward devising an effective and practical means for controlling the rate of population growth.

It is fully recognized that many of these proposals are general in nature and will require many years and considerable resources to carry out. However, the team was greatly impressed with the vigor, earnestness, independence and desire for improvement in the Haitian people.

Much can be accomplished, as recommended under Immediate Measures, from a small beginning with modest resources.

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