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Vol. XVII, No. 4 WASHINGTON April, 1906

THE NATIONAL GEOGRAPHIC MAGAZINE

OUR PLANT IMMIGRANTS *

AN ACCOUNT OF SOME OF THE RESULTS OF THE WORK OF THE OFFICE OF SEED AND PLANT INTRODUCTION OF THE DEPARTMENT OF AGRICULTURE AND OF SOME OF THE PROBLEMS IN PROCESS OF SOLUTION

By David Fairchild

Agricultural Explorer, in Charge of Foreign Explorations

THE era of pork and hominy has passed forever in this country, but so short a time ago that our fathers refer to it as the time of plain living. What has wrought this change throughout the table menus of the country since the days of the California gold fever? It is not the gold fields of the Pacific slope, nor the industrial development of the country that has caused it, so much as the introduction of new food plants. The changes that have been going on since those wagon caravans followed each other across the great plains have been gigantic, but in no respect have they been more remarkable than in those which Plant Introduction has brought about.

Slowly at first, with the establishment of those plants that the immigrants brought over with them, this work has gone on, unchronicled by historians, until today the very things that we look upon as characteristic of great regions of the country are vast fields and enormous orchards of introduced plants.

SOME NOTED IMPORTATIONS

The discovery of gold at Sutter's mill was the beginning of the great industrial development of the Pacific coast, but the introduction by the Catholic Fathers of a single forage plant—alfalfa—has turned two million acres of land into the most generally profitable farm area of this country.

These same Fathers brought with them to their missions olive cuttings, whose descendants today cover thousands of acres of the best tilled olive orchards in the world. A few orange cuttings from the east coast of Brazil, called to the attention of the world by an American woman, have grown until they number

* The substance of an address to the National Geographic Society, February 9, 1906, and published by permission of the Secretary of Agriculture.

their descendants by millions and form what is one of the characteristic features of California—its orange groves.

The tomato, which before the war was a curiosity from Peru and was used to frighten slaves into obedience, because they thought it poisonous, was grown last year on over half a million acres of garden land.

The lima bean, whose arrival in this country no historian has considered worthy of chronicling, has so grown in importance since its introduction, some time about 1820, that today special freight rates are granted it between southern California and the Atlantic coast, and thousands of acres of land where the rainfall is extremely light are devoted almost exclusively to the cultivation of this Peruvian bean.

The potato, from the highlands of Colombia and Peru; the rhubarb, from central Asia; the asparagus, from England, and even the celery of southern Europe, have all been, one after the other, introduced into our fields and gardens.

Though these great changes in the farm and garden areas of the country have been wrought in less than a lifetime, they have still been too slow, and today changes as far-reaching and important as the introduction of the olive or the orange are being brought about by government aid in a surprisingly short time.

The Department of Agriculture is growing in this country some of the things that we now import and for which we pay annually many millions of dollars; it is forcing into public notice and encouraging the trial of foods that the people of other countries find excellent and of which we are ignorant; and it is bringing in from all parts of the world plants that are now wild, but that can be tamed by breeding with others now in cultivation, thus contributing to the creation of fruits and vegetables that the world has never seen before.

This is the government enterprise of Plant Introduction—to introduce and establish in America as many of the valuable crops of the world as can be grown here; to educate the farmer in their culture and the public in their use; to increase by this, one of the most powerful means, the agricultural wealth of the country.

OUR FARMS AND FARMERS THE BEST IN THE WORLD

No nation in the world has an agricultural territory with a greater range of climatic conditions than the United States and its possessions. Great Britain, "on whose flag the sun never sets," has her colonies scattered through all the possible ranges of climate, but America has in one great connected area a territory that is exposed in its north to a temperature of fifty degrees below zero in winter and whose southern tip juts out into the zone of perpetual warmth.

This great farm land is peopled from one end to the other with pioneers; not with peasants whose fathers and grandfathers were peasants and who follow blindly in the footsteps of their forefathers, but with men who have the spirit of change in them and who are looking for anything that will pay better than what they already have. These pioneers, through the daily press and by means of the rural free delivery, are keeping in touch with the plant industries all over the world. They know what the wheat crop of the Argentine is likely to be, and whether Russia's output of this grain will affect the price of the wheat in their stacks. They see accounts of plant cultures in other lands that they would like to try in their own fields or gardens, and they have the time and the money and the land necessary; but they cannot get the seeds or plants to experiment with, nor do the papers tell enough to enable them to judge whether there is any chance of successfully growing these strange crops on their land.

"NEW THINGS TO GROW"

Millions of dollars are waiting to be invested in these new crops, and hundreds of thousands of private experimenters are ready to try new things.

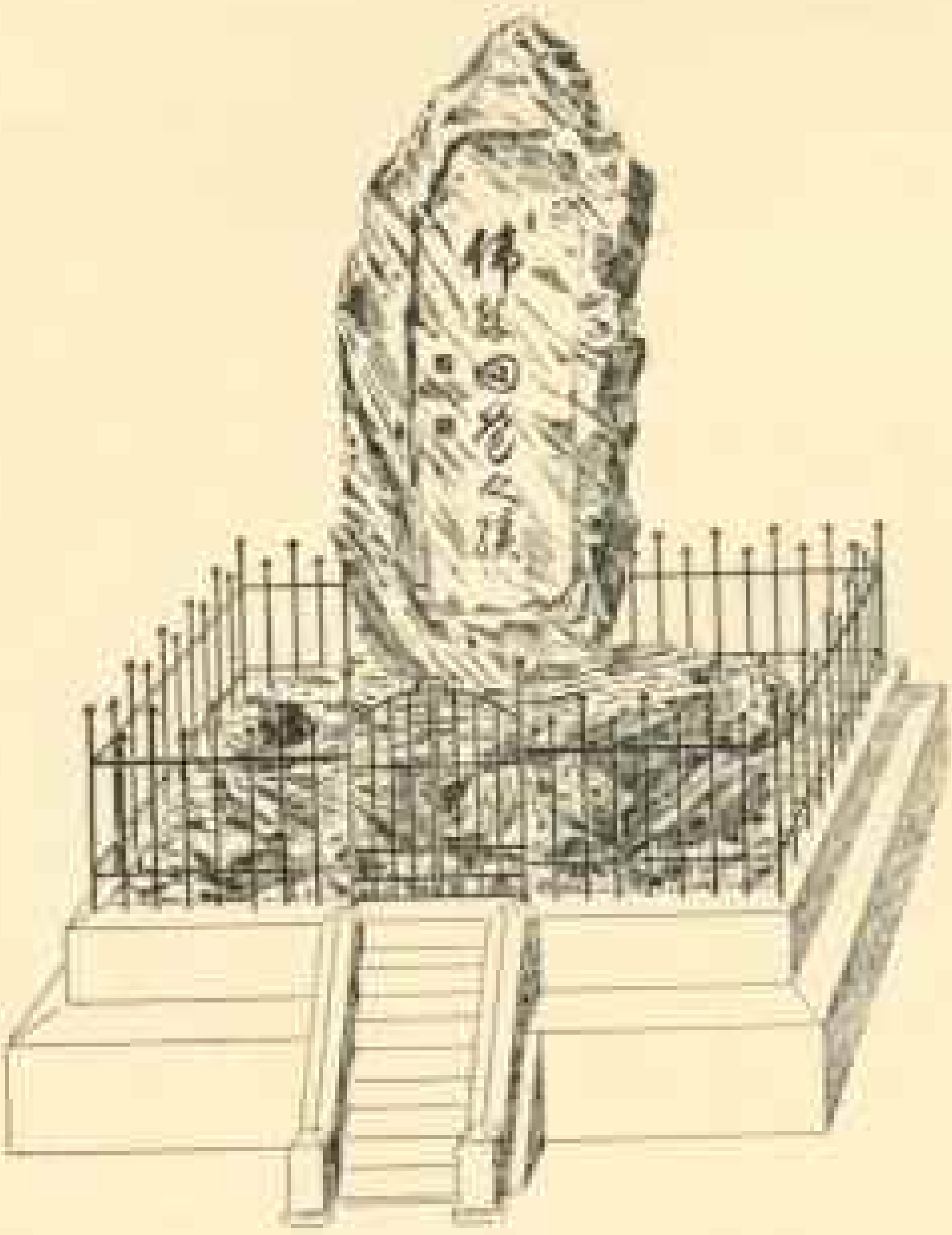
A flood of emigration has set in from our great cities to the country, and the emigrants are not poor people, nor ignorant, but are in large part the wealthy and intelligent, few of whom are willing to follow in the old ways of farming and gardening. They want something new to grow, not always because they think it will be more profitable, but because they will get more amusement out of it. To manage a farm and make it pay along the old lines is indeed a great accomplishment, but to take up something entirely new and prove that it will grow and be profitable gives the same kind of pleasure that always comes to one who makes two blades of grass grow where one grew before. It is the keen pleasure of discovery, the old pioneer spirit, that is turning from the creating of new business projects into new fields of agriculture. These are the new conditions in American agriculture that must be met by new means, and the Department of Agriculture, through the Office of Seed and Plant Introduction, is striving to meet these demands. This office, with its small appropriation of $40,000 a year for the introduction of foreign plants, is getting seeds and plants from the most remote corners of the world for thousands of private experimenters and for the state experiment stations of the country. Over a dozen new things a day are entered on the list of new arrivals, and these new seeds or plants arrive by mail, express, and freight, in quantities varying from a single cutting in a tin tube to a ton of seed of some African or Arabian grain.

These things are not sent broadcast over the country; they cannot be had merely for the asking. Each new shipment represents a well-thought-out problem, for which some preparation has been made, and the seed is too valuable to be wasted by putting it in the hands of those who want it merely because it costs nothing, or who live in a region which the meteorological data in the office excludes from consideration as a place where the new plant is likely to find a congenial home. The new arrival goes out to some experiment station or to some one who has satisfied the office that he has the necessary means to take care of it and the soil and climate in which it will be likely to grow—to experimenters, in other words, who have demonstrated their ability to try new plants. These are chosen from the organized institutes of research in each state and by correspondence with private individuals.

AGRICULTURAL EXPLORERS

The securing of these things from the ends of the earth is a work that has required the employment of exceptional men, whose enthusiasm for discovery would take them into dangerous places and whose training had fitted them to tell at a glance whether there was in a new plant the possibility of its utilization in this country. These men have been botanists in the main, but not collectors of dried plants. They have been investigators of new crop possibilities, and have kept always in view the fact that what the country wants is something that will grow and be profitable. The finding of a new species did not distract them from the object of their search, which was to find the plant, whether new to science or not, that was wanted for the improvement of an existing industry or the establishment of a new one.

The ground covered by these agricultural explorers has been great, and in this work of exploration the office has been most fortunate in enlisting the personal support of America's greatest traveler, Mr Barbour Lathrop, of Chicago. Mr Lathrop, at his own expense, conducted his explorations for nearly six years into most of the promising plant-growing regions of the world, taking the writer with him in all his travels as his expert. With the host of correspondents established during these long voyages and those made by the various agricultural explorers that the office itself has kept in the field, the machinery of getting new plants is better organized in this office than anywhere else in the world. We have traversed the Russian steppes and entered Turkestan; we have scoured the coast of North Africa from the Suez Canal to Morocco, visiting oases in which no white man has been for twenty-five years; we have investigated the industries of Italy, Greece, and Austro-Hungary; the Valley of the Nile, with its host of irrigated crops, has been given a thorough study; Japan, with its peculiar and suggestive agriculture, has been drawn upon by our explorers; India and the Dutch East Indies, with their wealth of material of value for the warmer portions of the country, have been touched, but not yet explored; Arabian date regions have been visited and their possibilities exploited; South America has been given a short visit of reconnaissance; and East Africa, Cape Colony, and the Transvaal, Sweden, and Finland have been visited but not explored. The almost unlimited plant resources of the Chinese Kingdom are being probed by a trained agricultural explorer, Mr Frank N. Myer. Hosts of things are coming in from his explorations that we are not yet in a position to talk about, since few of them have left the cool chambers in which they will remain until planting time, in the spring. Hardier persimmons and peaches from the original home of the peach, interesting new grapes, luscious Chinese pears, and hardy bamboos are on the long list of things already en route to America.



Monument in Churchyard of Fukushoji, Province of Kii, Japan, erected as a memorial to the man who first introduced citrus fruits into Japan 1,800 years ago. His name was Tajima Mori, and he was sent to China by Imperial order to obtain the citrus fruits. It took him nine years to secure the plants for introduction. The monument bears the following inscription: "How Magnificent is the Result of Tajis' Work"

A glance at the great plant industries of this country shows that they have nearly all of them been influenced in the past and are still being changed and bettered by the introduction of new plants.

THE DURUM WHEAT INDUSTRY

The durum wheat, from which the bread of the common people is made in Southern Europe and Russia, was almost an unknown thing on our grain markets until 1900; but today it is a living question in the milling centers of the Northwest. It is a wheat for the dry lands, where the ordinary kinds grow poorly or not at all, and it yields so much more per acre and is so much surer a crop that, even if it should not bring the highest prices, it will pay better than the less drouth-resistant species which Western farmers have hitherto tried to grow on the dry farm lands of the Dakotas and Nebraska.

Custom still fights the innovation of a new flour, and there are people who think our bread is in danger of being deteriorated by the new introduction; but they are not the well informed who have tasted the full-flavored durum wheat breads of Spain or Italy or who realize the great and growing future of macaroni as a food in this country. American-made macaroni, prepared with the best of the old American wheats, cannot be compared with the delicate product of a Gragnano factory. But with the culture of this durum wheat in America a change is coming, and the time may come when we shall ship macaroni to Italy instead of importing it at the rate of nearly $2,000,000 worth a year. This innovation in the great wheat industry has been the result of the efforts of Mr M. A. Carleton, who was sent to Russia as an agricultural explorer of the Office of Plant Introduction in 1898 and 1900. The office has distributed thousands of bushels of the durum wheat varieties gathered by him from all the Mediterranean and South Russian countries where it is grown.

THE SMYRNA FIG

One of the most fascinating events in the history of plant introduction was the introduction of the Smyrna fig industry. The Smyrna fig has always been considered the finest fig in the world, and beyond all competition; so it was natural that progressive Californians should wish to see if they could not grow it. Orchards were accordingly started in 1880. They grew well, but the crops of fruit they bore fell to the ground when quite green, and it was evident that something was lacking to make the industry a success. A study of fig culture in Smyrna was made, and it was discovered that a process called caprification was necessary. This consisted in hanging in the trees of the true Smyrna fig the young fruits of another variety of figs that are not edible, but which contain thousands of microscopic wasp-like insects, called *Blastophaga*. These insects creep out of the caprifigs just at the time when the Smyrna figs are in bloom, and, crawling into the latter, they fertilize the hundreds of small flowers of which the fig is composed, and instead of dropping off like unfertilized flowers, the Smyrna figs grow and ripen.

The caprifigs were accordingly imported as cuttings, but again the owner was disappointed when the trees bore, for it was discovered that they had left their tiny insects behind and were worthless. A final attempt was made through the combined efforts of the entomologist of the Department of Agriculture and Mr W. T. Swingle, of the Bureau of Plant Industry, and, in 1899, after nineteen years of effort, Mr Roding's orchard of Smyrna figs was established. It is still the largest in this country and has been yielding large crops of delicious fruit. Sixty-five tons was the output for 1903, and though in its infancy the California Smyrna fig industry is already supplying a portion of the figs now sold in our markets, and these are being put up with a cleanliness unknown in their native land.

JAPANESE RICE

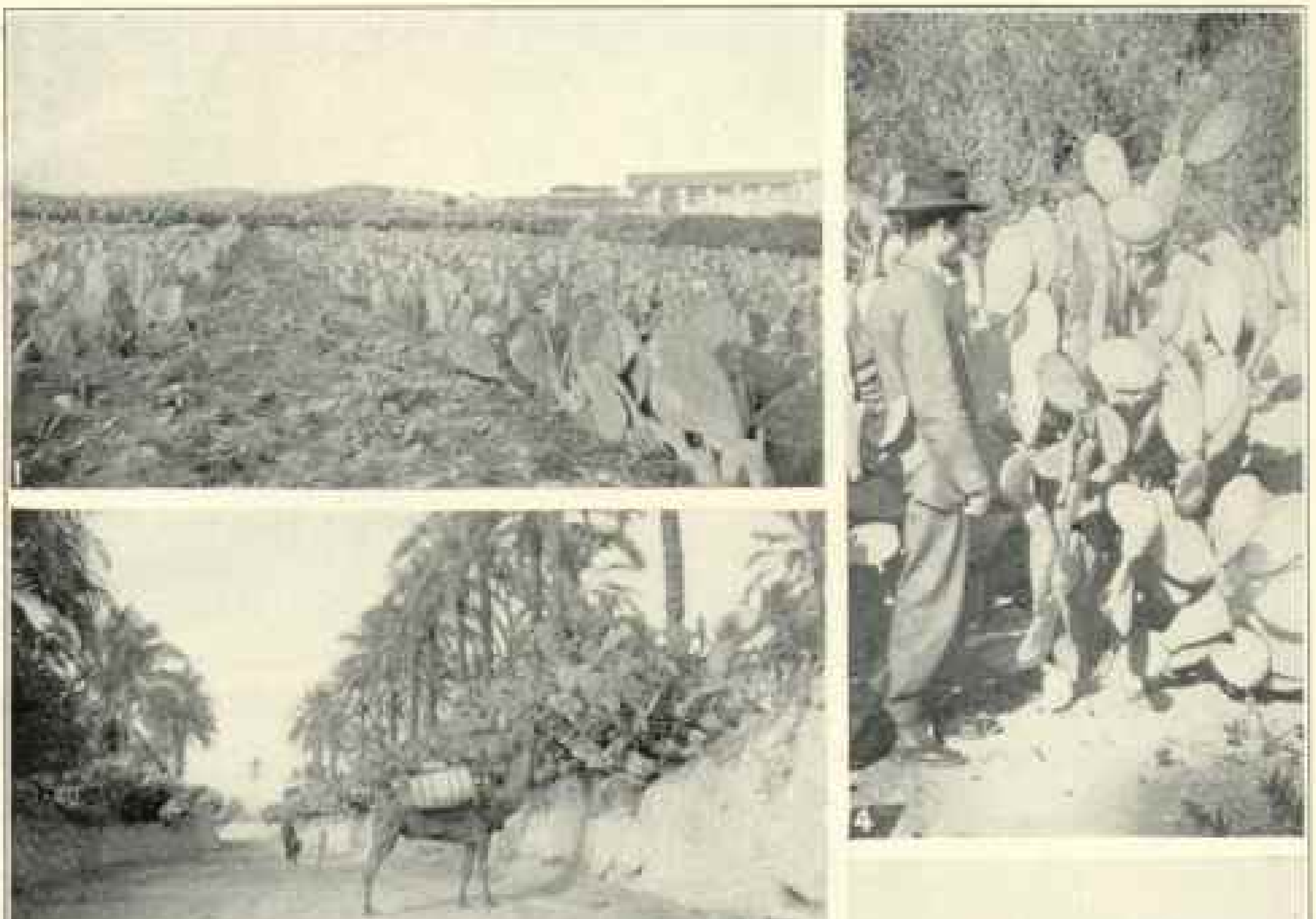
History tells us that the first rice in this country was introduced into the Carolinas in 1695 by the captain of a brig from Madagascar, who gave some seed to Governor Smith and his friends to experiment with, and the result has been an important industry. The rices which chance introduction had brought in were looked upon as the finest in quality in the world and were exported to Europe; but with the call for a whiter and a more polished product than the hand-threshed rice of plantation days came machine-polished rice, and the center of the rice industry was transferred to Louisiana and Texas by the discovery of artesian wells in those states. The machine-polished rice that we buy in this country today is, as every one knows, a truly beautiful thing to look at, but as tasteless as the paste that a paperhanger brushes on his rolls of wall paper. The leather rollers of the machine not only rub off all the fine outer layer of nutritious matter, and with it the part that gives flavor to the kernels, but they often break the long, slender grains that characterize the famous Carolina golden rice. This breakage is so great that the Louisiana growers begged for assistance, and the new Office of Plant Introduction sent Dr S. A. Knapp to Japan in search of a short-kerneled variety that would not break in the milling process. Today Dr Knapp declares that one-half of all the rice grown in Louisiana and Texas is the Kiushu rice that had its origin in the introduction made in 1899. This new rice has reduced the breakage from 40 per cent to 10 per cent, and has at the same time brought into culture a more productive rice. It has not done away with the pernicious practice of polishing, but an interest in the unpolished rice has lately been aroused that, it is hoped, will lead to the abandonment of a practice which robs the buyer of nearly all of the flavoring matter of the rice and leaves only the starchy portion. It is a disgrace that the most intelligent nation in the world should be so ignorant of the food value of the crop, on which more people live than on any other, that they should insist upon having their rice made as shiny as polished glass beads, although in so doing they are throwing away the best part of it. No rice-eating people treat their rice as we do, and it is to be hoped that the small markets that have been started for the unpolished rice in this city and elsewhere will lead to a general propaganda in its favor.

THE CORSICAN CITRON INDUSTRY

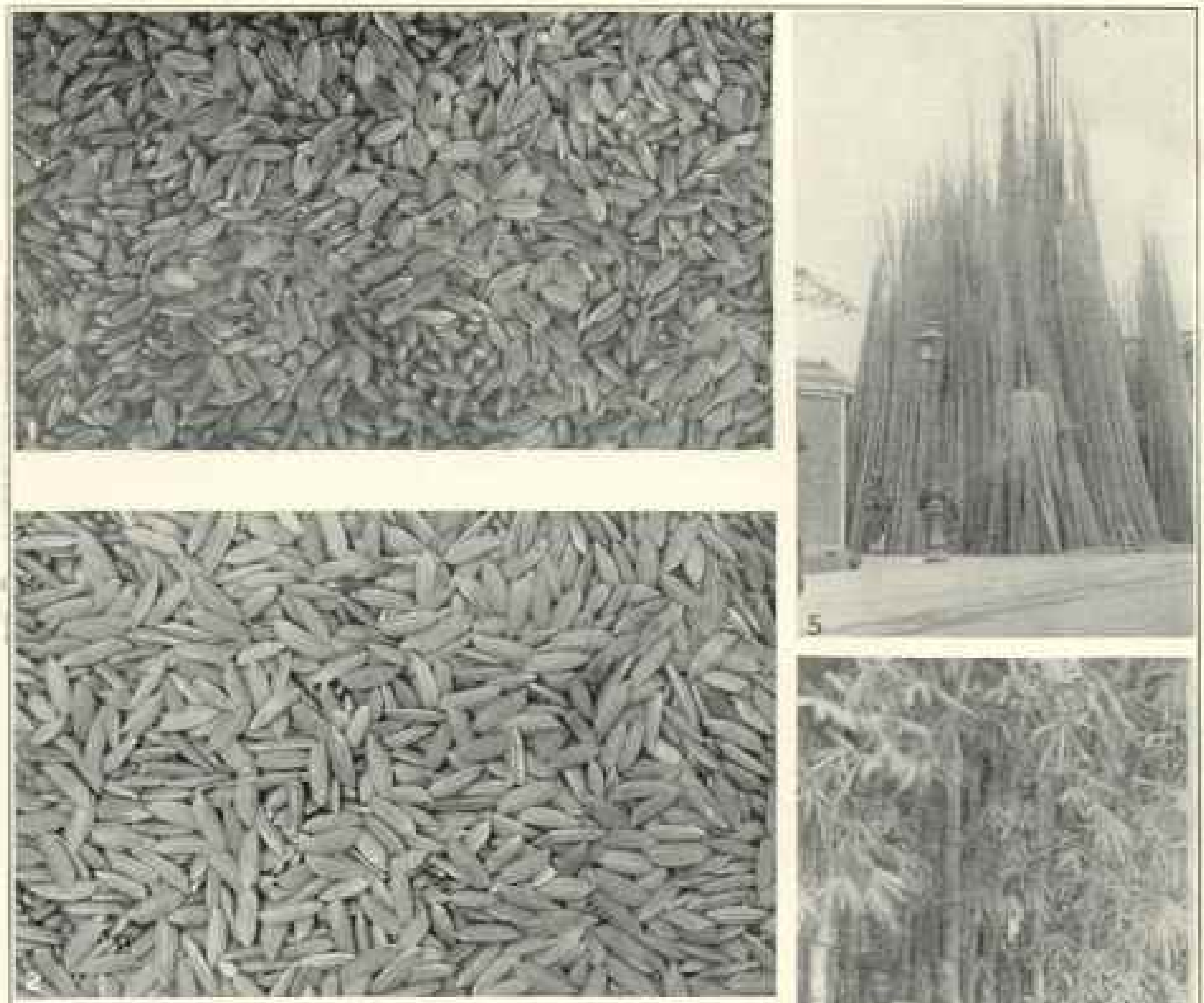
The Corsican citron is better known to housewives than to the general public, though a failure to put thin shavings of candied citron rind into the poundcake would be quickly noticed by the household.

Though no one person eats in a year any large amount of citron, yet every one eats a little, and the aggregate amounts to over 2,000,000 pounds a year, almost all of which is imported from Italy and Corsica. To assist a progressive Californian who thought he had the right kind of land and a climate in which to grow the Corsican citron, the writer was sent to the birthplace of Napoleon by the pomologist of the department in 1894. It was the first time I had ever tried to get from a foreign people the plants with which to start an industry that would eventually remove one of its best buyers from the field and might some time lead to the appearance of a rival industry. I was nervous and had been advised that the Corsicans were not inclined to let scions of their fine citron trees go out of the country; so on landing at Bastia, the the port nearest Italy, I pushed through to the center of the island; and there, in a small mountain town, perched on one of the characteristic pinnacles of land, surrounded by groves of citron, I made my mission known to the mayor.

While waiting for him to bury one of his friends in a neighboring village I strolled about the place and sought by means of my camera to dispel the suspicions of the crowd that gathered uncomfortably about me. While I stood with my head under the black focusing cloth, with a young mother and her child posing against the stucco wall before me, I was startled by the touch, not too gentle, either, of the *guarde civile* of the village. *"Vos papiers, si'l vous plait,"* was the curt demand. I replied in Italian that I had left them at Bastia, at which response, and to the evident delight of the crowd, I was marched off to jail. On an errand that was not likely to be pleasing if explained to the guard, with no papers in my pocket, with a captor whose very look was enough to terrify any one, and in a jail that would rival in filthiness any that the Inquisition ever had, I think there are few men who would not have paled. Seated in the jail, with the guard and his wicked-looking wife glaring at me, I was asked to give an account of the reason of my visit. This I refused to do, but endeavored to find out why an American was arrested for taking pictures of the beauties of this lovely village. To my surprise I found that I was



1. A Field of Spineless Cactus in Tunis. Planted for fodder. See page 194
2. A Camel browsing off the Spineless Cactus of Tripoli
3. An Orchard of the Carob in full bearing in Spain. See page 190
4. The Spineless Cactus of Tunis
5. The Egyptian Papyrus. Most beautiful of water plants for Florida streams



1. The Short-kernelled Japanese Rice that does not break in milling. See page 184
2. The Long-kernelled Rice which broke badly when milled
3. A Japanese Colonist in his Field of Japan Rice in Texas
4. Macaroni made in Naples. Exposed to the dust and dirt of the street
5. A Bamboo Timber Yard in Japan. See page 199
6. A Clump of the Giant Bamboo in Natal, South Africa
7. Trees of the East Indian Mango. The noted Bombay variety. See page 187

taken for an Italian spy, and the examination of all my belongings only served to increase the suspicion, for it revealed Italian notes on abstruse botanical subjects. For hours I fought in poor Italian for a release, but not until I found, in a pocket that had been overlooked, a Treasury check for some small amount, and insisted that this was my paper of citizenship, did the guard reluctantly let me go, and I left the town as quickly as I could, cutting from some citron trees as I went, however, enough scions or bud sticks to graft a small orchard.

It was my pleasure, ten years after this, to visit in southern California the orchard that was the result of the introduction of these scions. The industry is on a paying basis today, and Dr Westlake, of Duarte, has his own factory in which he candies a grade of citron that he claims is more digestible than any now sold on our markets.

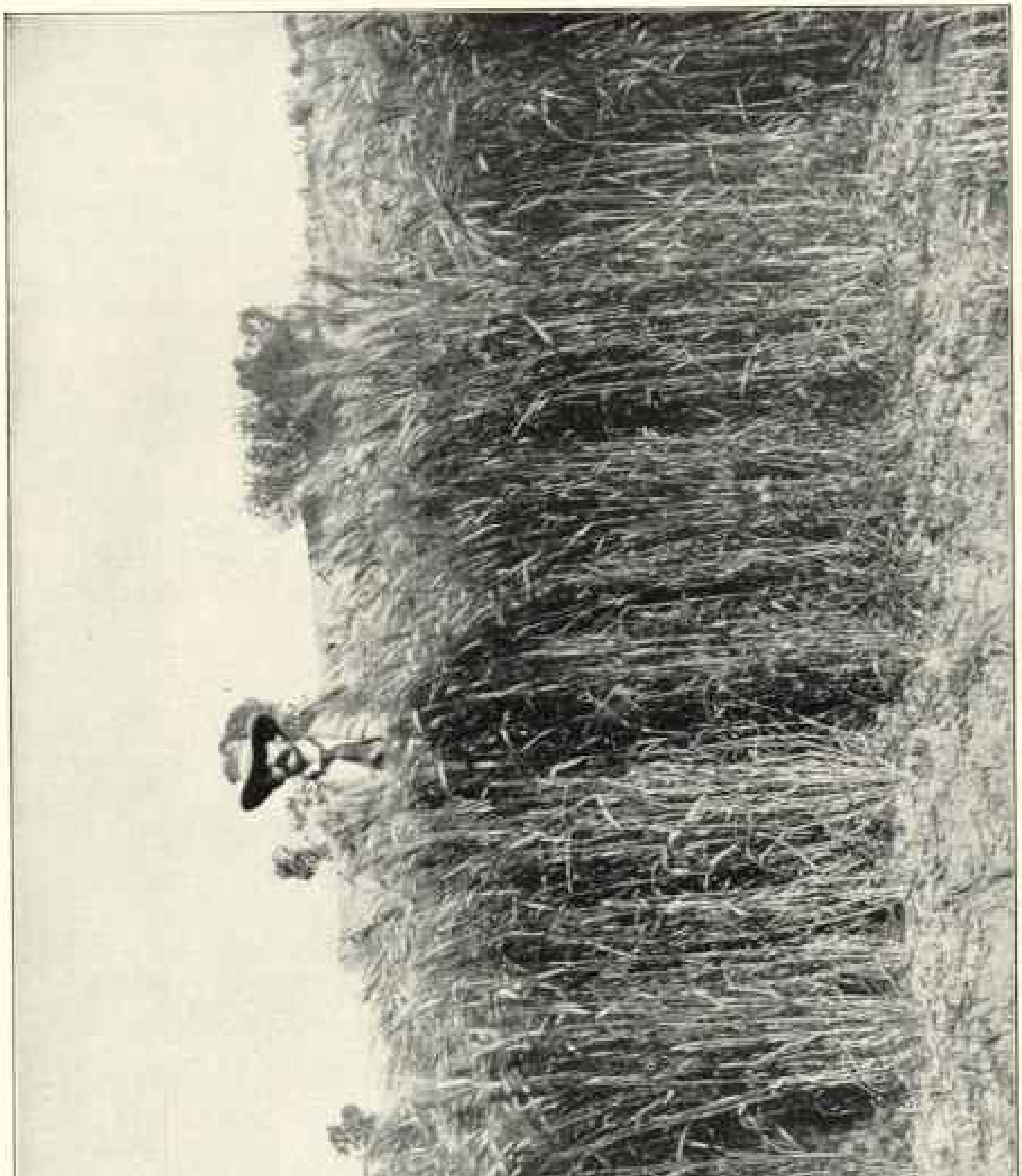
UDO, A NEW JAPANESE SALAD PLANT

While there is nothing that has been found yet that will compare with lettuce as a salad plant, the Japanese have a vegetable that will give a welcome variety. In Japan it is as common as celery is with us, and is so popular that it is canned and sent to this country for the use of the thousands of Japanese who live here. It is used cooked with Soy sauce and in many other ways, but it might never have been introduced into America but for the fact that a young American girl, Miss Fanny Eldredge, adopted the thick, blanched shoots, two feet long or more, as a salad. By shaving them into long, thin shavings, and serving with a French dressing, she produced a salad with a distinct flavor of its own, a crispness that was unusual, and a pretty silvery appearance. It was found to be a most vigorous grower, resembling a soft wooded shrub more than anything. The methods of its culture were worked out, and seeds were obtained and distributed to hundreds of private experimenters scattered from Nova Scotia to California and from Maine to Florida, and the result has been that shoots suitable for the table have been produced in a dozen places, chiefly on the Atlantic coast. It has grown almost if not quite as well in Washington as in Japan, and has shown itself a heavy yielder. Seedlings have in one year produced astonishing masses of roots, from which quantities of the blanched shoots have been grown in a dark chamber or under a mound of earth.

THE TROPICAL MANGO

Many people think they know what mangos taste like because they have eaten some fruit by that name sold in one of the fruit stores of our cities. The fruits that are offered now as mangos are unworthy the name, for they are from worthless seedling trees and are little more than juicy balls of fibers saturated in turpentine, while the oriental mango is a fruit fit to set before a king. It is in fact more richly flavored than a peach and has no more fiber. The trees grow on poor soil and attain an extreme old age. They bear enormous crops of fruit, that make the trees look when in full bearing as though they were covered with a mass of gold.

The first introduction of the East Indian Mulgoba mango was made into Florida by the Office of Pomology in 1889. From the one tree of this early introduction which survived the freeze of 1895 has come the new mango craze that is now at its height among the Florida planters who have suitable soil and no frosts or only slight ones. When this tree, saved from destruction by Prof. Elbridge Gale, of Mangonia, came into fruit it was a revelation to America, to the Western Tropics in fact. From this one tree thousands of grafted trees are now growing in Florida, and it will not be long before the mulgoba is for sale on our markets. To meet the demand for the best mangoes in the world, the office has brought young plants of the best varieties from every region where they are grown, and there



From M. A. Carleton, U. S. Department of Agriculture

A Durum Wheat Field at the New Mexico Experiment Station. See page 182

20,000,000 bushels of this wheat were harvested in the United States in 1905 is now assembled in the green-houses of the department the largest and best selected collection of mangoes in the world. These are being fruited in Florida, and the best will be propagated as rapidly as possible for distribution.

SPANISH HARD-SHELLED ALMONDS

The Sierras of southeastern Spain produce most of the long, slender kernelled almonds which have come so rapidly into favor for salted almonds. California could produce them, as she already grows the poorer kinds, the soft-shelled, coarser-flavored sorts. To get these finer kinds, the famous *Jordan* especially, the writer explored the almond orchards of Malaga and Andalusia, and cut scions or grafting wood from the best trees. Much of this material has been used in California with success, but the *Jordan* flowers too early, and another expedition must be made in search of later flowering kinds from the same region to make the hard-shelled type a success, or else new regions must be found in this country where the *Jordan* will not be caught by the late spring frosts.

BERSEEM, THE EGYPTIAN CLOVER

The greatest annual irrigated forage crop for culture in regions with mild winters is the berseem of the Nile Valley. It is the crop that the Egyptian *fellah*, or peasant, has depended upon for centuries as a soil-improver and as a plant on which to pasture his cattle and other animals of the farm. Planted in the late autumn, it grows so rapidly that before the next June it will yield four cuttings of a most nutritious fodder that may be pastured upon, fed green, or made into hay. No other plant known should be so well suited to grow in those newly opened up, irrigated regions of Arizona and California whenever the settlers learn to grow high-priced annual crops instead of alfalfa, which is the main plant industry in that region now. Berseem will not come into competition with alfalfa, for it is an annual, while alfalfa is a perennial, and therefore not suited to grow in rotation with crops like cotton, melons, or other annuals. The trials so far made with berseem are encouraging, and the plant has seeded at various places in California and acre plots of it have been grown.

THE DATE-PALM INDUSTRY

The transfer from the great deserts of the old world to those of the new of the unique date industry is an accomplishment of which the government may well be proud. It is something that private enterprise would not have undertaken for decades to come, and the name of Mr Walter T. Swingle will be always associated with this new industry. Though the attention of the public was first attracted to the possibilities of growing the foreign date palm in this country through chance seedlings that bore fruit, and through an early introduction of the pomologist of the department, it was the exploration trip of Mr Swingle to the Desert of Sahara in 1899 that first proved the feasibility of starting commercial date plantations in Arizona and California. From the time when the first large shipment of palm suckers reached the Southwest until the present, the Office of Plant Introduction has had an explorer in some one or other of the great date regions of the old world gathering plants for the government plantations. Today the list of introduced varieties numbers over 170, and more than 3,000 palms, large and small, have been imported and planted out. The best sorts from Egyptian oases, selected kinds from the valley of the Tigris, the famous dates of southern Tunis, and even the varieties from uncivilized Beluchistan, have been gathered into what can proudly be called the best collection of date varieties in the world. This search through the deserts of the world has revealed the fact that the dates of our markets are only one or two kinds of the host of sorts known to the true date eaters, the Arabs, and that those we prize as delicacies are by no means looked upon by the desert-dwellers as their best. The search has brought to light as well the hard, dry date, which Americans do not know at all, and which they will learn to appreciate as a food, just as the Arab has. Already Egyptian and Algerian imported palms have borne and ripened fruit, and many persons in close touch and sympathy with the work have sampled the first fruits of the newly introduced industry.

To all of us who have seen the date palm forests of the old world deserts and who have followed the progress of the experiments in this country, the landscape of the deserts of Arizona and California will not long be thought of without the presence of these stately plants that have so much that is biblical and ancient about them.

THE CAROB TREE OR ST JOHN'S BREAD

No tree of the Mediterranean region is more beautiful than the Italian carrubo, the carob or St John's bread of the English. In Sicily it is under its shade that the tired tourist stops to rest, and in Spain it is the orchards of the algaroba that attract his attention by their dark-green foliage and picturesque form. Few realize that this tree is seldom planted for its shade or for its landscape effect, but for its pods.

These are born in profusion and are most highly prized as fodder. There are carob-sellers in Spain, just as there are barley-buyers here, and these sellers export their carobs to this country in large quantities. The thick brown pods are full of a sweet honey-like fluid that runs out if you break them open. Cattle and horses are exceedingly fond of them, and children eat them, too, even in this land of cheap candies. Their nutritive value is high, so high in fact that a Wisconsin manufacturer makes one of the best calf foods on the market out of them.

The carob has already found a home in our West, and there are fruiting trees near Los Angeles to prove that it has come to stay.

EGYPTIAN COTTON INTRODUCTION

America is the greatest cotton-producing country in the world, but nevertheless over 112,000 bales of cotton were imported from Egypt in 1899. There are distinctly different kinds of this great staple, and the Egyptian cotton supplies a different demand from the so-called upland cotton of this country. It is a variety with a long, very silky and crinkly fiber of a light-brown color, and has been found better than the upland for the manufacture of stockings and underwear and for mixing with silk. It is not the equal of the Seal Island cotton that is grown on the islands off the Atlantic coast, but the area in which the Sea Island varieties can be grown is very limited and the supply is disposed of at fancy prices. It was thought that the Egyptian cotton might be successfully grown in the South, and numerous attempts to introduce it have been made by the department; but while the plants grew well, they proved poor yielders, and their culture has been abandoned, although Dr H. J. Webber has since made a large quantity of hybrids between this Egyptian cotton and the upland sorts and these are more promising.

In the great Colorado River valley, however, which is the American Egypt, and has its dry, mild climate, its irrigation systems, and its long growing season, the Egyptian cotton promises much. There fields of it have been grown that resemble in almost every way the great fields along the Nile, and with the rapid increase in population that is taking place along the Colorado River will come the demand for this, the great money-making crop of Egypt.

ALFALFAS FROM TURKESTAN AND ARABIA

From many standpoints alfalfa is the greatest forage crop in the world, and when its immense money value is considered the importance of a better va-

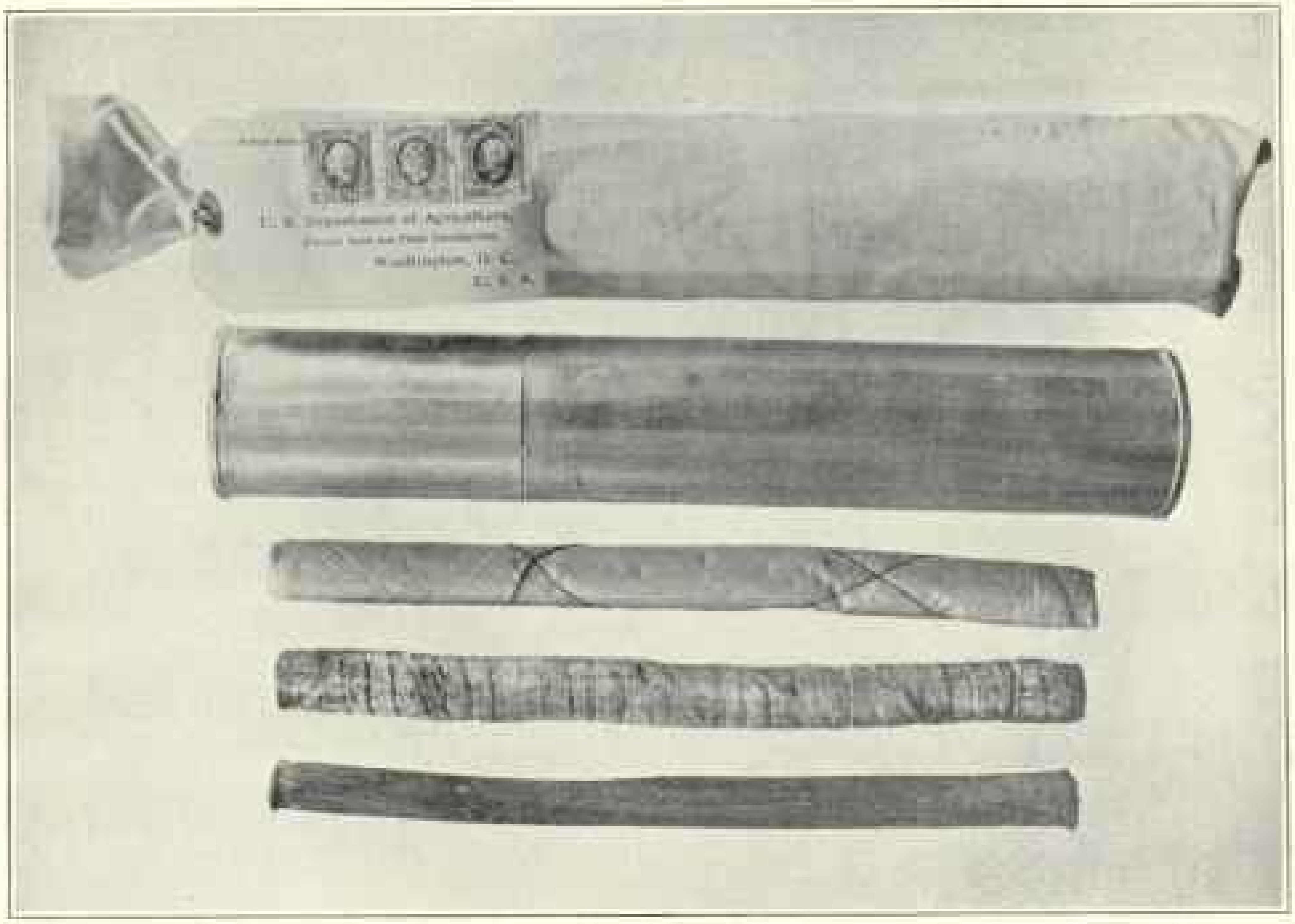


Photo from U. S. Department of Agriculture

A Sample Cutting and the way it is put up and mailed to the Department of Agriculture

riety, that costs no more to grow than the ordinary one, becomes apparent.

It found its way into this country probably from Asia Minor or Arabia through the roundabout way of Chile. Since its introduction by the Friars in the fifties, its culture has spread, until the area covered by it is over 2,000,000 acres.

With the thought that there was no reason why this Chilean alfalfa should be the best in the world, Mr N. E. Hansen, the first explorer of the office, brought home with him seeds of alfalfa which he found on his exploring trip to the steppes of Siberian and Russian Turkestan.

It is only grown there in small patches, that are cut with sickles in a most primitive fashion. Distributed in large amounts, this seed has proven to be of a variety more resistant to drouth and alkali than the ordinary kind, and it is now being grown in acre areas in many parts of the West. While in Arabia three years ago the writer found and imported seed of an alfalfa which the Arab date-growers cultivate, and this has made such an unusual growth in the irrigated regions of the Southwest that the farmers think they can get an extra cutting of hay from it each season.

THE MALIN HORSERADISH FROM BOHEMIA

Horseradish culture in this country has been generally neglected. Until the introduction by the Office of Plant Introduction of the famous Malin horseradish, only one sort, the common American, was known. In a little village near Vienna the best horseradish in the world is grown. There are two or more other

From Gustav Eisen, U. S. Department of Agriculture

Packing Figs in a Smyrna Fig Establishment

Photo from George C. Roeding, of Fresno, California

Distributing Insect-laden Figs in a Smyrna Fig Orchard in order to fertilize the flowers. See page 183

sorts that are recognized in the markets of Europe, but though sold as larger roots, these are not so fine flavored nor so crisp as the *Maliner Kren*, as it is called. The methods of the Malin peasants, too, are superior to those practiced in America, and it was thought at one time that to this difference in method of cultivation rather than to the variety itself was to be attributed its superiority. The introduction of the Malin roots, however, has proven that it is a superior kind. In New Jersey, at Edgewater Park, one of the first men to get the roots grew over six acres this season. Though he had on the same kind of soil, and adjoining the plat where he cultivated the Malin, the American sort, it yielded a ton of roots more than the native kind, was several weeks earlier in coming to maturity, thus commanding a higher figure in the early season, and produced a larger, more regular root. These favorable characters combined have made the Malin horseradish a much better paying one than any other, netting the planter $100 an acre more than the American.

This is a small industry, it is true, but in a single county in that state it has grown from the production of a few hundred pounds a year to that of more than 1,000,000, which means a decided increase in five years in the earning power of a community.

THE MANGOSTEEN FROM THE MALAY ARCHIPELAGO

There is not in the whole range of fruits a single one that surpasses the tropical mangosteen in delicate flavor or in beauty; and yet, because the West Indies do not grow it, Americans who stay at home cannot taste it. Trees, few in number, it is true, are now grown in Jamaica, Trinidad, and even in Hawaii, but the propaganda in its favor has not yet been made and we are now pushing an investigation to establish it as a new industry in Porto Rico, Hawaii, and on the Panama Canal Zone. The mangosteen has a poor root system and it is one of the lines of research we are following to find among the near relatives of the species a form that has better roots and that will serve as a stock upon which to graft the more delicate mangosteen. The genus to which this wonderful fruit belongs has at least fifteen edible species in it, few, if any, being known to those who have not made them a special study. It has a beautiful white fruit pulp, more delicate than that of a plum, and a flavor that is indescribably delicate and delicious, while its purple brown rind will distinguish it from all other fruits and make it bring fancy prices wherever it is offered for sale.

THE TUNA, A FRUIT AND FODDER PLANT FOR THE DESERTS

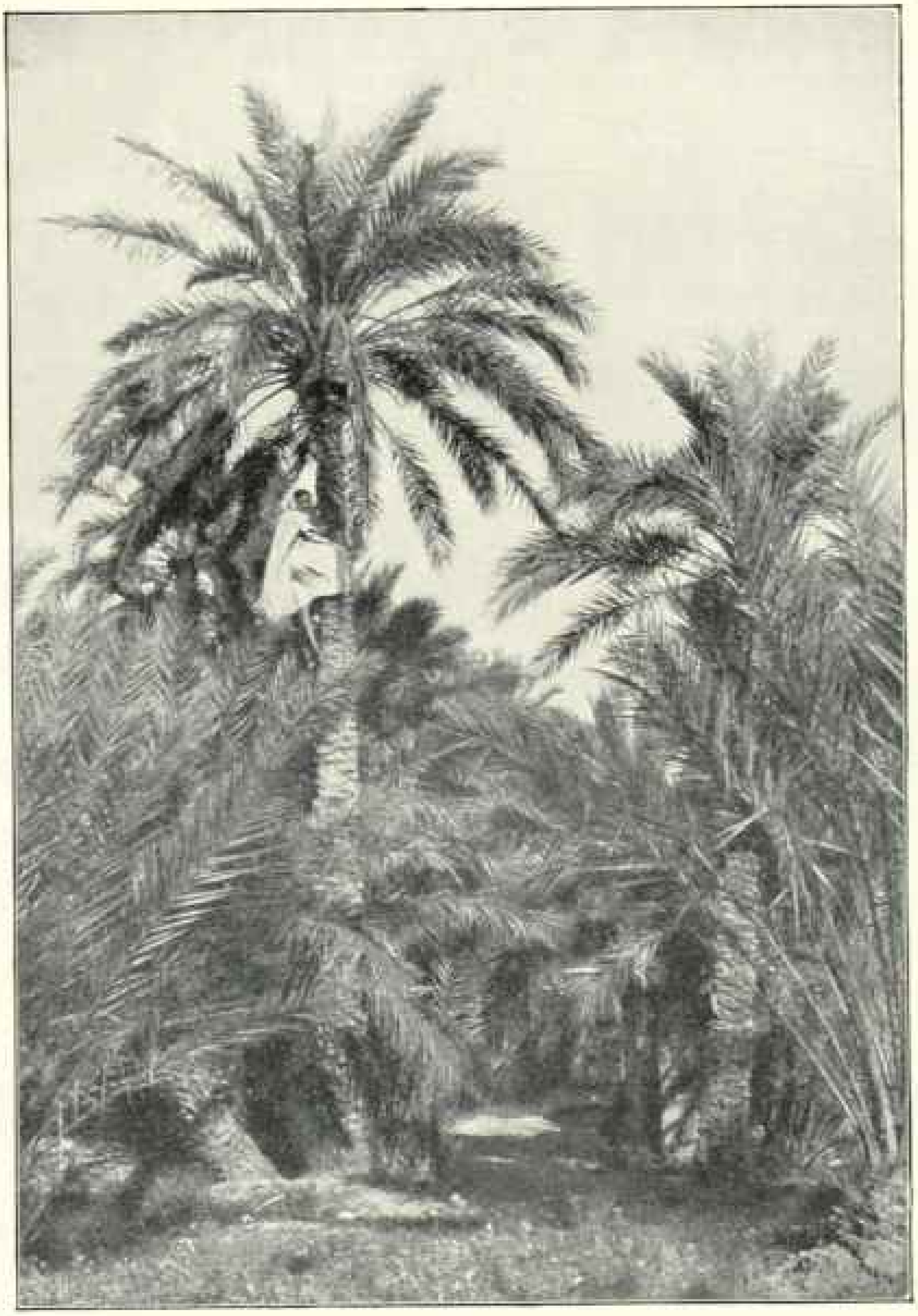
The prickly pear, or tuna, is a fruit that all those who have been in Mexico or Italy or who have visited southern Spain have seen and perhaps tasted. Few, probably, have thought that this fruit was the product of a cactus that would grow in the dry deserts where scarcely anything else will live, and produce fruit on which men can live. It furnishes a fodder for cattle, too, that, though not of the best, is at least good enough to make it worth while to cultivate it in the old world, and in the new it has been utilized by burning off the sharp spines. Native in Mexico, but introduced into the Mediterranean region and into South Africa at a very early date, it has developed astonishingly there, and it is from these parts of the world and from Mexico that we are getting for Mr Griffiths, the opuntia expert of the department, all the different varieties. These he is growing in special gardens in California, and it is safe to say that he has already assembled there the largest collections of these plants in the world.

The newspapers have quoted Mr Luther Burbank as claiming to be the originator of the spineless cactus. I do not think that he claims this, but he does think that the so-called spineless forms that the Office of Plant Introduction has brought in are not perfectly spineless, and that he can by breeding and selection remove every vestige of the long spines, and also the almost microscopic spicules that are even more objectionable than the spines, or at least quite as much so.

What some of the possibilities of the opuntia are Mr Spillman, of the Department, has described in a lecture before this Society. The situation is one of the most fascinating in the whole range of plant breeding. Here is a tremendously variable desert plant that can be grown where other plants die; one that can be grown from cuttings as easily as a begonia; one that yields enormous crops of a fruit that is so nutritious that in Tunis, Morocco, and South Africa the natives live on it for months at a time. Though it is so full of seeds that the American fails to appreciate it, it is a fruit of which there are in existence almost entirely seedless varieties from which superior seedless forms can be made; a plant the joints of which are already used for fodder by burning off the spines, making it of value even in the wild state, and of which there are nearly spineless forms now in cultivation in Tunis, Argentina, and southern Spain. Add to this the fact that it is a tremendously rapid grower when given water, and that practically nothing has been done to improve it, and the great possibilities of the plant become apparent.

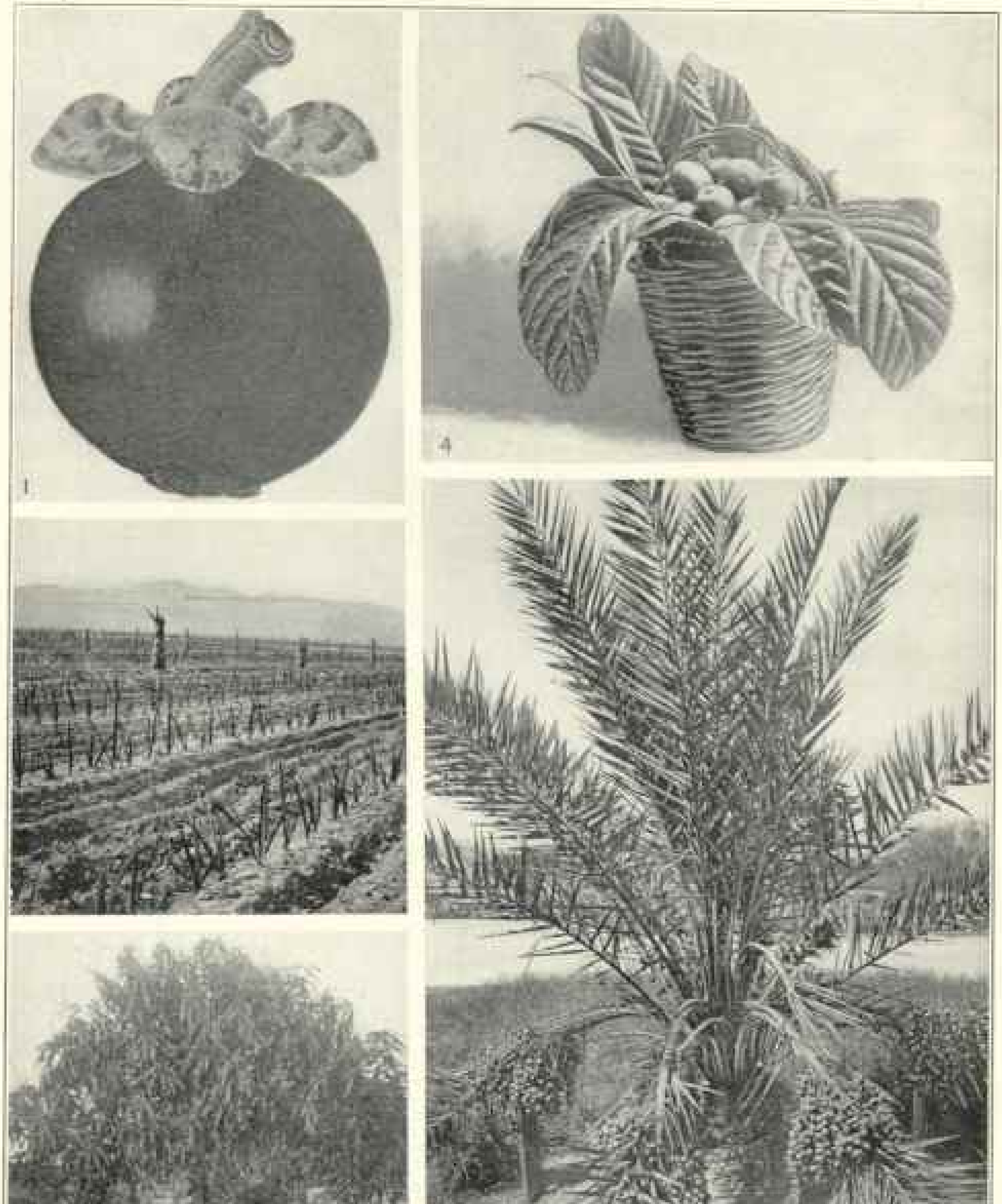
THE CHAYOTE, A NEGLECTED WINTER VEGETABLE

Unless assisted, it takes a long time for even good vegetables to become



From Z. T. Swingle, U. S. Department of Agriculture

An Arab climbing a Tall Palm in a Garden at Biskra, Algeria, to pollinate the flowers



1. The Mangosteen, queen of the tropical fruits. One-half natural size. See pages 183-184
2. The beginning of the Government's Date Garden in California. See page 189
3. A young imported Mulgoba Mango Tree in Florida. See page 187
4. A basketful of Japanese Loquats as sold in the market of Malta. One of the new fruits of promise
5. A young California Date Palm loaded with fruit

popular. If one could patent them and control the supply, men would take these new things up and push them, just as they have new breakfast foods, of which they can control the processes. But a new vegetable, what man of moderate means wants to spend all the time and money necessary to advertise it, only to find that his neighbor has waited for a market, and when such has been created has gone into the culture of the new vegetable on a big scale and is underselling him?

The chayote is one of many such neglected opportunities. It is a cucumber-like vegetable, borne on a vine which can be trained over a trellis just like a grapevine. It bears large crops of fruit, as many as 500 to the vine. It is a perennial and does not have to be planted every year, as the cucumber does, but goes on for years producing larger and larger crops. The fruit keeps excellently, and as late as March can be sent to the northern markets. Its roots are edible, its young stems as tender as asparagus, while its fruits can be prepared in twenty ways or more. The plant adapts itself to culture under glass and bears fruits there, even in the north, though its natural home is in the West Indies, and it will not be a profitable outdoor culture north of the Carolinas.

With all these points in its favor, which were first called to the attention of the American public by Mr O. F. Cook in a bulletin of the Department, and with the further fact that it has been for years a favorite vegetable among the creoles of New Orleans, there are today none of these vegetables to be had on our northern markets.

To bring its good points to the attention of those who are looking for new things, the writer introduced it to Managers Hilliard and Macormick, of the Waldorf-Astoria, and the Bellevue-Stratford hotels. These men, whose business it is to cater to the jaded appetites of the rich, have pronounced it an excellent thing, have invented new recipes for cooking it, and have put it for the first time on their menus.

If a small demand is once created in our great cities for this new vegetable, that tastes like a combination of a delicate cucumber and a squash, with more firmness than either, there will be created a new industry for the South that will grow as the tomato industry has grown and support people by its yearly earnings.

PLANT PROBLEMS NOW IN PROCESS OF SOLUTION

The work of Plant Introduction is not theoretical, but practical in character. Its operations are carried on in those places where it is needed, and the problems are suggested by practical men. Some of the problems which the department is now working on are: the finding of paying crops for the abandoned rice farms of the Carolinas; the securing of some profitable plant culture for the unemployed hilly regions of North Carolina and Georgia; the improvement of the brewing barleys of the country; the fitting in of new crops into the arctic agriculture of Alaska; the starting of new industries in our tropical possessions; the increasing of the fertility of the California orchard soils; the introducing of hardy fruits into the Northwest; the substituting of a valuable for a worthless cane in the cane brakes of the South, and the exploiting of a drouth-resistant nut plant for California.

The planters of the Carolinas must have a new crop to grow on the rich rice lands that are no longer profitable for rice culture since the great Louisiana and Texas rice fields have been opened up. The Office of Plant Introduction has suggested the trial of the Japanese matting rush as one likely to be a profitable one on these areas, and is planting thousands of seedlings of the plant, and watching them carefully to see how expensive their cultivation will be. It is also experimenting with a new root crop on the cheap sandy lands of the region as a possible substitute for the Irish potato, which will not grow on that soil.

Original appearance of Salt Lands

There are also thousands of unemployed acres of hilly lands in the Carolinas where the conditions are good for the culture of the Japanese plant from which the finest writing paper in the world is made, and the Office has introduced and planted there thousands of these plants to see if they will not develop into an industry which will utilize these great waste areas.

The barley-growers of the country are growing millions of bushels of grain for the brewers; but among the hosts of so-called varieties that are recognized on the grain markets not one is a pure race or breed. The Swedes have long since found the use of pure barleys of great advantage to the brewers, and their plant-breeders have created pure types. The Department has imported these, and they are now on extensive trial by the best barley-growers in the country.

Alaska, with its cool, short summers and extremely cold, long winters, offers new problems for Plant Introduction. The crops cultivated by the farmers of the great plains are accustomed to a long, hot summer, and when tried in Alaska they are caught by the early autumn frosts before they are half ripe. To meet these new conditions, Norway, Sweden, and Finland have been drawn upon for grains and vegetables, and the most successful oats grown in Alaska today are the Finnish black oats that were introduced by the Office of Plant Introduction.

For the tropical regions of Porto Rico, Hawaii, the Philippines, and the Panama Canal Zone, there are hosts of new possibilities open. The sisal fiber importations from Mexico cost this country over $16,000,000 a year, and we propose to demonstrate on a practical scale that the sisal plant will grow in Porto Rico and supply a share, at least, of the thousands of miles of binding twine which the Western farmers use in their harvest fields.

There are a host of new fruits which are common in the oriental tropics and which would quickly win their way to popular favor on our markets, waiting to be brought in and made into thriving industries. The run-down coffee varieties need new strains to invigorate them, and it is a possibility that the wild coffees of Abyssinia which Consul Skinner has secured for the Department will bring this about. There are new root crops like the taro, the yautia, and

Appearance of the same Salt Lands two years after planting of Berseem

the tropical yam that are almost unexplored, so far as their possibilities as food for the white man are concerned, and whose excellent qualities and remarkable yields put them in the same rank with the potato.

THE CURIOUS PROPERTIES OF THE FENUGREEK

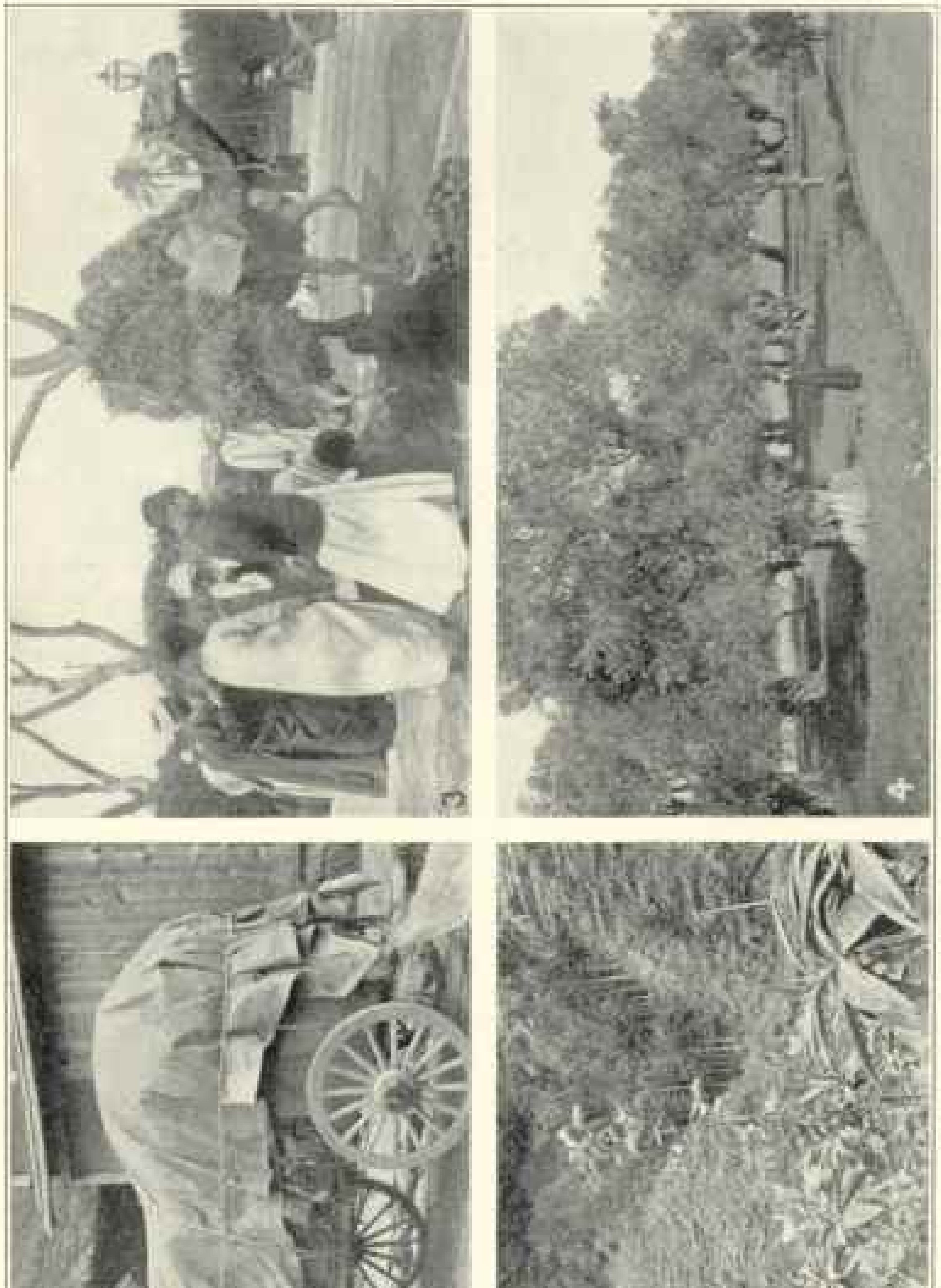
The great fruit-growers of the Pacific slope, with their thousands of acres of clean-tilled orchards, have been searching for a cover crop that would increase the fertility of their lands and add the necessary humus or vegetable matter to it. We have found this for them in the shape of a leguminous plant that inhabits the Mediterranean region—the fenugreek. The seeds of this plant, curiously enough, are eaten by the Jewish women of Tunis in order to make them fat, and no young Jew in that region would think of marrying a girl until the use of this grain had increased her weight to the fashionable figure of 250 or 300 pounds. The seeds form a part of the expensive condition powders that stockmen use to prepare their stock for the fat-stock shows, and it was for this purpose that our explorers introduced it in the first place.

For the great Northwest, where fruit trees are killed every winter and none but the hardiest kinds will grow, the explorers have brought in from Russia the hardy Vladimir cherry and forms of the Siberian crab-apple, with the hope of at least starting some types of fruit that will be hardy there.

The "cane brakes" of the Southern States are thickets of an American bamboo whose stems are so brittle that they are worthless in the arts. Shipments of the Japanese timber bamboo, from which the thousand and one beautiful Japanese things are made, have been imported and are being tried in those areas to see if they will not grow there and occupy land that today is the ranging ground of wild hogs and half-wild cattle.

A DROUTH RESISTANT NUT

Thousands of acres of almond orchards in California have been unprofitable because the rainfall is too light in the regions where the orchards have been started; and to get a more drouth-resistant nut plant for these areas the pistache from the Levant has been brought in, and there are now being set out at various places in California small



1. A Wagon Rain Covering, four years old, made of Mitsumata paper, and oiled with Perilla oil. See page 198
2. A Hillside in Japan covered with the Mitsumata Paper Plant
3. Camel loads of Berseem entering Cairo in the early morning. See page 189
4. Century old Olive Orchards in the island of Zante, Greece

pistache orchards, the pioneers of the new pistache industry, that will some day make this delicious nut as common as the almond is, not as a coloring and flavoring material for ice creams, but as a nut for the table, to serve as salted almonds are now. Mr Swingle, the enthusiastic introducer of this nut, has searched throughout the world for all the pistache species that can be found, some to use as stocks and others to breed from, and there is every prospect that he will succeed in introducing into the arid regions of the Southwest an entirely new nut industry.

These are some of the many problems that the government enterprise of Plant Introduction is engaged in solving.

They are problems that private enterprise will not naturally undertake; they are problems that concern the wealth-producing power of American soil; they are problems that the government has shown its ability to solve in a manner involving an insignificant outlay of the public funds. They encourage the production of food and other products that we now import from other lands, and they concern the establishment of farm industries which, for generations to come, will support hundreds of thousands, perhaps millions, of American citizens.

MODERN TRANSMUTATION OF THE ELEMENTS*

BY SIR WILLIAM RAMSAY

THE story of helium is perhaps one of the most romantic in the history of science; and it is a story of which the last chapters are still unwritten. Originally seen as a spectrum line in the chromosphere of the sun, it was discovered on the earth twenty-eight years later; and it has provided the first authentic case of transmutation—a problem which occupied the alchemists from the sixth century.

On August 18, 1868, an eclipse of the sun was visible in India. Among those who observed it was the celebrated French astronomer Janssen, and for the first time a spectroscope was employed to analyze and trace to its sources the light evolved by the edge or "limb" of the sun. It appeared that enormous prominences, moving at an almost incredible rate, were due to hurricanes of hydrogen. That the gas blown out beyond the shadow of the moon was really hydrogen was revealed by the red, blue-green, and violet lines which characterize its spectrum. Among these lines was one occupying nearly the position of the two lines characteristic of the spectrum of glowing sodium, named D^1 and D^2 by Fraunhofer; and this third line was characterized as D^3 by Janssen. On October 20, 1868, Sir Norman Lockyer, in a note presented to the Royal Society by Dr Sharpey, mentioned that he had "established the existence of three bright lines" in the "chromosphere," a word suggested by Sharpey to denote the colored atmosphere surrounding the sun; one of these was "near D." It was known that an increase of pressure had the effect of broadening spectrum lines; and Frankland and Sir Norman Lockyer were at first inclined to attribute this new line to a broadening of the sodium lines, owing to the pressure of the uprush of gas, causing the hurricane. However, neither this hypothesis nor a subsequent one, that

* From the Athenæum.

the new yellow line might possibly be ascribed to hydrogen, could be maintained; and hence the line was attributed to the existence of an element in the sun unknown on the earth, and the name "helium" was chosen as an appropriate reminder of the habitat of the element.

Among the lines visible in the chromosphere ten are always observed. Of these four may be seen in the hydrogen spectrum, one is due to calcium and four to helium; there is still one unidentified with the spectrum of any known element; it has the wave length 5316.87, and the source has been named "coronium." It appears at a great height in the solar atmosphere, and it is conjectured that it must be lighter than any known gas.

Shortly after the discovery of argon, in 1884, the notice of one of the discoverers was drawn to an account by Dr Hillebrand, of the United States Geological Survey, of the presence in certain ores containing uranium of a gas which could be extracted by an air pump. Hillebrand examined the spectrum of the gas and supposed it to be nitrogen. It is true that he saw in it spectrum lines which could hardly be ascribed to nitrogen; but on mentioning the fact to his colleagues he was bantered out of his quest and did not follow up the clue. Now, in the spring of 1895 attempts were being made to cause argon to combine, and it was argued that conceivably Hillebrand's gas might turn out to be argon and might give an indication to a possible compound. Consequently a specimen of clevite—one of the minerals which Hillebrand had found to give off the supposed nitrogen in largest quantity—was purchased and the gas was collected from it. On purification its spectrum showed the presence of a brilliant yellow line almost identical in position with the yellow lines of sodium. It was soon evident that the solar gas, helium, had been discovered on the earth.

The visible spectrum of helium is comparatively simple, and many of its lines have been identified among those of the solar chromosphere. It is also to be detected in many of the fixed stars, notably Capella, Arcturus, Pollux, Sirius, and Vega. It is one of the lightest of gases, being only twice as heavy as hydrogen, but unlike hydrogen, however, its molecules consist of single atoms, whereas those of hydrogen consist of paired atoms, which separate only when hydrogen enters into combination with oxygen or other elements. This peculiarity appears to render liquefaction of helium almost impossible; for while hydrogen has been liquefied and boils at 422 degrees Fahrenheit below zero, helium has been cooled to —438 degrees Fahrenheit and has been compressed to one-sixtieth of its ordinary bulk, and yet has shown no sign of liquefaction. Indeed, it is now the only "permanent" gas, for it has never been condensed into liquid form.

The minerals which contain helium have one thing in common: they all contain uranium, or thorium, or lead, or a mixture of these. Minerals of lead alone do not show the presence of helium; but it may be stated that helium is an invariable constituent of ores of uranium and thorium. It was at first supposed that such minerals contain helium in a state of combination; but this view could not be substantiated, for the constituents of these ores do not show any tendency toward combination with helium. The connection of this with what follows is very remarkable.

The explanation of the fact that compounds of radium discovered by Madame Curie in 1901 are permanently at a temperature considerably above that of the atmosphere, and that they are continually emitting corpuscules of high velocity, was given by Professor Rutherford and Mr Frederick Soddy in a series of papers communicated to the *Philosophical Magazine*. It is that radium and allied bodies are "disintegrating"—that their atoms are spontaneously flying to bits. Now, this view, although new in its application to elements, has long been known to hold for certain compounds. There is a fearfully explosive compound of nitrogen with chlorine, which on the least touch resolves itself suddenly into its constituent elements. It is true that here we have a molecule composed of atoms "disintegrating" into atoms which subsequently combine to form new molecules of nitrogen and of chlorine; but in principle an analogy may be drawn between the disruption of the molecules of an explosive compound and the disintegration of an atom into corpuscules. Professor Rutherford and Mr Soddy showed, however, that corpuscules which have been proved by Professor J. J. Thomson, of Cambridge, to be exceedingly minute are not the only products of disintegration of the radium atom; the proof was adduced that among these products were atoms of a density comparable with that of hydrogen and helium. This hypothesis evidently admitted of experimental proof, and in conjunction with Mr Soddy I collected the "emanation" or gas evolved from salts of radium. We showed that this gas, presumably of high density, disintegrates in its turn, and that perhaps 7 per cent of it changes into helium. What becomes of the remaining 93 per cent is as yet undecided; still, some hint may be gained from the fact that a constant ratio exists between the amount of helium obtainable from a mineral and the weight of lead which it contains. It may be that lead forms the ultimate product, or at least one of the ultimate products, of the disintegration of the atom of emanation. Another radioactive element, actinium, has been shown by its discoverer, Debierne, also to yield helium by the disintegration of the emanation or gas which it continuously evolves.

This disruptive change is attended by a great evolution of heat; for the radioctive elements are in a sense explosive, and explosions are always accompanied by a rise of temperature. But such atomic explosions surpass in degree, to an almost inconceivable extent, the molecular explosions with which we are familiar. Could we induce a fragment of radium to evolve all its energy at once, the result would be terrific, for in the energy with which it parts during its change it surpasses in explosive power our most potent guncotton by millions of times. It has been suggested that to this or similar changes are due the continued high temperature of the sun and the presence of helium in its chromosphere.

Up to the present no further cases of transmutation have been observed than those mentioned—radium and actinium into their emanation, and these emanations into helium. But proof is accumulating that many forms of matter with which we are familiar are also undergoing similar change, but at a vastly slower rate. "The mills of God grind slowly"—so slowly that many generations of men must come and go before ocular proof is obtained of the products of such possible transmutations.

BRAZIL AND PERU

THE enthusiasm with which Brazil and the other republics of South America are preparing for the Pan-American Congress at Rio de Janeiro this summer well illustrates the commercial prosperity and the political permanence which practically the entire continent is now enjoying.

Brazil began the twentieth century with 17,000,000 people, a territory larger than that of the United States, and undeveloped resources surpassed by no country with the possible exception of the United States and China. Consul Seeger writes as follows:

Of all the South American countries Brazil is the most extensive. It contains an area of 3,200,000 square miles, is 2,630 miles long, 2,540 miles wide, and has a population of 17,000,000, mostly of Indian origin. It borders on every country of South America except Chile.

The rivers are numerous, among the largest being the Amazon, Madeira, Negro, Para, Tocantius, Parana, and San Francisco. In the extreme northern part of the country are the llanos, or grassy plains, on which roam millions of horses, many being caught and sold in the different markets of the world. Central Brazil, especially that part lying contiguous to the Amazon and its tributaries, is called the silva, or forest region; it abounds in Para rubber and palm trees, mahogany, and dyewoods. The eastern and southern parts form the great Brazilian plateau. On account of the climatic conditions and the fertility of the soil, this section is especially adapted to the cultivation of the coffee tree, the production of sugar, cotton, tobacco, rice, and fruits. Among the minerals, besides gold and diamonds, iron of superior quality is abundant. The emerald, ruby, topaz, sapphire, garnet, and other precious stones are found in considerable quantities. Quite large quantities of corn and wheat are grown in the Amazon basin, but none for export.

Brazil is a country of varied and wonderful resources, and with the introduction of up-to-date methods its development could be extended so that within a few years it would produce enormously and take high rank among the leading commercial countries of the world. The export trade is increasing at a very rapid rate, especially in that of rubber, which amounts to millions of dollars annually. The introduction of the bicycle, automobile, and other rubber-tired vehicles has given the rubber production an impetus that has caused it to forge to the front as the leading export of the country. The coffee trade is being extended and has a very healthy growth. The United States buys 50 per cent of the coffee exported, which amounted to $46,922,974 during the year ended June 30, 1904.

Of the three leading countries that sold their products to Brazil in 1904, Great Britain ranks first, with $34,076,266, or 28 per cent of the total amount; Germany second, with $15,975,118, or 12 per cent; the United States, $14,041,970, or 11 per cent. The great disparity in the amount of goods sold by Great Britain and the United States to Brazil presents a problem that must be studied by the manufacturers and exporters of this country if their trade with that and the other South American countries is to be extended.

In recent years a large amount of foreign capital has been invested in Brazilian enterprises, especially in the city of Rio de Janeiro, Sao Paulo, and in the southern states. German capitalists have established steamship lines for coast service, and American and Canadian capitalists have acquired the car lines, gas works, and telephone service at Rio de Janeiro, the money invested being estimated at $25,000,000.

NAVIGATION RETURNS

During the year 1904 there entered at the several ports of Brazil 17,407 steamers and sailing vessels, of 11,879,563 tons, being an increase of 1,339 in number of vessels and 811,265 in tonnage. Of these 13,452 vessels or 4,589,544 tons were Brazilian, 1,792 or 3,661,010 tons were British; 737 or 1,730,375 tons were German; 392 or 829,526 tons were French; 168 or 363,301 tons were Argentine, and practically none from the United States.

The American Consul General at Callao, Peru, Mr Gottschalk, writes that a Peruvian loan of $14,610,000 gold has been awarded to the German Transatlantic Bank of Lima, as the representative of the Deutscher Bank of Berlin. Peru is to issue bonds for the loan at 98½ net, bearing interest at 7 per cent. One per cent of this will be devoted to canceling the debt. The award was made after the offers were carefully considered from a London bank, a Paris bank, two New York banking firms, and the German institution. The people are elated over the favorable terms, which, joined to the fact that a former loan was also taken up by Germany, greatly strengthens the prestige of the local German bank and German commercial prestige throughout Peru.

WALTER WELLMAN'S EXPEDITION TO THE NORTH POLE

AT a meeting of the Board of Managers of the National Geographic Society on March 16, 1906, President Willis L. Moore in the chair, the following resolution, moved by Dr Alexander Graham Bell and seconded by Rear Admiral Colby M. Chester, U. S. N., was unanimously adopted:

"*Resolved*, That it is the sense of the Board that the plans outlined by Mr Walter Wellman for reaching the North Pole are carefully and thoroughly considered, and give good promise of success;

"That the Board heartily approves of these plans, and will do everything in its power to aid in carrying them out;

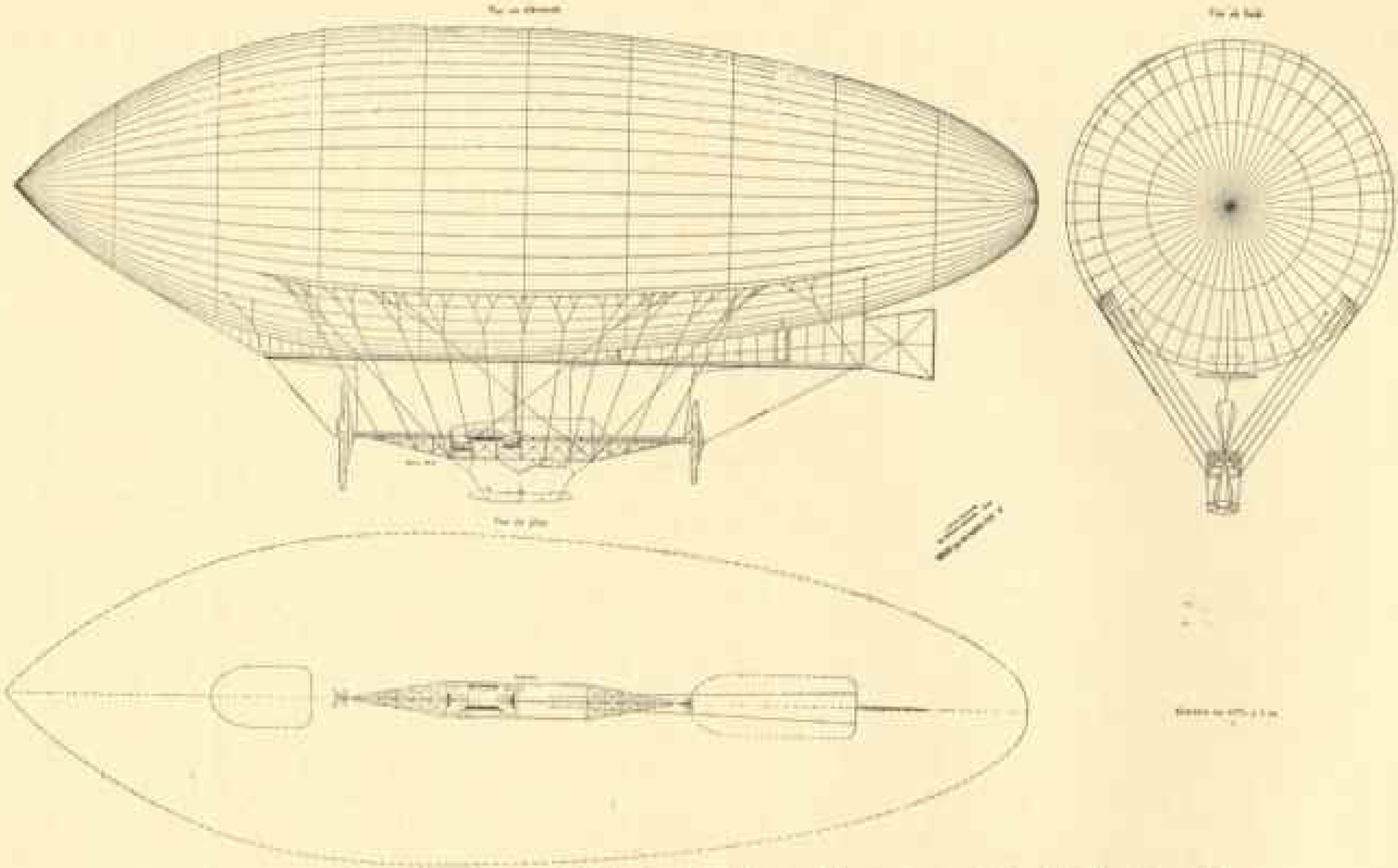
"That the Board accepts Mr Wellman's proposition to send a scientific representative, and will, as far as possible, see that such representative is equipped for the work involved."

Major Henry E. Hersey has been appointed the representative of the National Geographic Society to accompany Mr Wellman, and the scientific program is now being arranged by the Research Committee of the Society, consisting of Vice-President Henry Gannett, Chairman; C. Hart Merriam, F. V. Coville, A. J. Henry, O. H. Tittmann, C. W. Hayes, L. A. Bauer, W. H. Holmes, O. P. Austin, and C. M. Chester.

When the Spanish-American war began, Major Hersey was in charge of the climate and crop work of the U. S. Weather Bureau in Arizona. He obtained leave of absence, raised a regiment, and offered his services to the government. Only part of the regiment was needed, so that Major Hersey was transferred as captain to the Rough Riders, of which he was the ranking major when the war closed. Since then he has been connected with the U. S. Weather Bureau. Probably two additional men will accompany Mr Wellman and Major Hersey in the airship voyage.

The first announcement that Mr Wellman would attempt to reach the North Pole in an airship was made on December 31, 1905. Mr Victor Lawson, the principal owner of the *Chicago-Record Herald* and a life member of the National Geographic Society, supplies the money. His public spirit and generosity in thus supporting an expedition which will probably cost more than $250,000 before it is completed is deserving of the highest respect and appreciation. The expedition has been incorporated under the laws of Maine, with Mr Lawson, president; Mr Frank B. Noyes, editor of the *Chicago-Record Herald*, treasurer, and Mr Wellman, general manager. The plans of the airship were determined after much deliberation with the leading experts in aeronautics of France.

Among Mr Wellman's advisers were Alberto Santos-Dumont; the engineer, Henri Julliot, who built the Lebaudy dirigible and who has just been accorded the grand cross of the Legion or Honor; Commandant Renard, of the army, representative of the distinguished family whose names are famous in the history of aerial navigation; Commandant Bouttiaux, chief of the army aerostatic station at Meudon; Captain Voyer, assistant chief and a man of great experience in aeronautics and with dirigibles; M. Goupil, well known mathematician, the greatest authority in France on aerial screws, engineer, and chevalier of the Legion of Honor; Captain Ferber, an expert not only in aeronautics, but in aviation; M. Edouard Surcouf, a well-known constructor and engineer, who is now building a dirigible for M. Deustch (de la Meurthe); M. Louis Godard, the aeronaut and constructor who has built scores of ships of the air and who has



General Features of the Plans for the Airship of the Wellman Chicago Record-Herald Polar Expedition

Engineer Louis Godard's plan, printed above, shows the proportions and in part the details of the greatest airship ever constructed. The dimensions of the huge balloon are as follows:

	Meters	Feet
Length	50	164.04
Greatest diameter	16	52.49
Surface	1,961 sq	21,098 sq
Volume	6,350 cube	224,244 cube

	Kilos	Pounds
Lifting power (hydrogen at 1k., 110 per meter cube)	7,048	15,538
Lifting power (hydrogen at 1k., 140 per meter cube)	7,240	16,000
Weight of airship, steel car, motors, and machinery, complete	3,000	6,600
Weight of crew, instruments, wireless and other apparatus, gasoline	4,240	9,400

Duration of inflation, 15 to 20 days.

The motive power is composed of two motors, one of 50 and the other of 25 horsepower, driving two screws, and giving speeds of from 12 to 15 statute miles per hour.

The length of the car, which is made entirely of steel tubing, is 16 meters, or 52.5 feet.

The engine-room and cabin for the crew are inclosed. The steel boat is carried suspended below the car.

This boat serves as a working deck for the manipulation of the guide-rope equilibreur and retardateur, and also for storage of gasoline. In case any accident happens to the airship it is to be used by the members of the crew in sledging their way back to the headquarters.

made 500 ascensions; the engineer and mathematician, Andre, who is M. Godard's scientific collaborator; Gaston Hervieu, an engineer and aeronaut, who is also an expert mechanic; Alexandre Liwenthaal, who was associated with Count Zeppelin in the famous airship experiments in Germany and Switzerland, and others.

Mr Wellman gave to M. Godard the contract for the construction of the great airship, and the work is now under way. The aeronef is to be completed in May. All its motors, propulseurs, and mechanical parts are to be thoroughly tested in Paris. In June all the paraphernalia of the expedition is to be assembled at Tromsoe, Norway, where the ice steamer *Frithjof* is lying—a craft well known in Arctic annals, having been used by the Wellman expedition to Franz Josef Land in 1898, and employed later by the Ziegler expedition.

About June 20 the *Frithjof* will sail for Spitzbergen, and Mr Wellman expects to establish his headquarters at Low Island, North Spitzbergen, latitude 80° 20′, about July 1. The party will at once proceed with the erection of headquarters buildings, a huge shed large enough to hold the airship when inflated, gas apparatus, etc. An idea of the large scale upon which the expedition is organized may be gained from the fact that at the headquarters will be assembled about 35 men, including the scientific staff, engineers, aeronauts, mechanics, sailors, and workmen. To make the hydrogen for inflation of the airship 105 tons of sulphuric acid and 75 tons of iron filings are taken. During the latter part of July the airship is to have its trials under meteorological and other conditions almost identical with those which prevail along the route to the Pole.

The expedition has announced a two-years' campaign for the Pole, and has chartered the *Frithjof* for the seasons of 1906 and 1907. If upon being carefully tested the dirigible is found to be in fit condition for the voyage, an effort to reach the Pole will be made this year. If not, the flight over the Arctic Ocean will be deferred till next year, as Mr Wellman has announced that he will not start till all his equipment is in the best possible order, whether it be this year or next. If the final attempt goes over to 1907, the party will return in the autumn and spend the winter and spring reconstructing the airship in the light of the summer's experience, improving and strengthening it, and, if necessary, building an entirely new aeronef.

An interesting feature of the expedition is the plan to maintain wireless communication between the Arctic regions and the outer world. Wireless station number 1 will be established at Hammerfest, Norway, in touch with the Atlantic cable. Station number 2 will be at the expedition headquarters in Spitzbergen, and it is expected that constant communication between these points, 600 miles apart, can be maintained. Station number 3 will be on the airship, and it is believed that messages can be sent from the neighborhood of the Pole itself to the headquarters at Spitzbergen, and thence to Hammerfest, in case the expedition should be fortunate enough to reach the vicinity of the Pole.

The period of the whole trip by dirigible is assumed at 10 days, or 240 hours. Mr Wellman believes the airship can be kept in the air as long as 20, possibly 25, days, because the loss of ascensional force should not be more than 200 pounds per day through leakage of gas, or say 5,000 pounds in 25 days, while in that time he expects to burn 5,500 pounds of gasoline in the motors, thus lightening the load by this much, not counting the provisions consumed, etc. He carries gasoline enough for about 140 hours of motoring at approximately 12 miles per hour. Hence each assumed period of 10 days is divided into 140 hours motoring and 100 hours drifting with the retardateur.

THE POLAR AIRSHIP

By Walter Wellman

AIRSHIP construction and operation is an art which has not made much progress in this country, although Knabenshue, Baldwin, and perhaps others have done interesting and valuable work on a small scale. In this country the prevailing conception of an airship is that of a gas bag of small size, relatively, covered with a netting of ropes or steel wires, and with sufficient lifting capacity, when inflated with hydrogen gas, to carry the balloon, a light framework of bamboo or wood, one or two men, and a small motor, with a sufficient supply of fuel to run it for a few hours.

The dirigible which M. Godard and his corps of experts have in hand is an entirely different sort of affair. Its great size enables it to lift not only the balloon, but the car of steel, the three motors, comprising a total of eighty horsepower, two screws or propulseurs, a steel boat, moto-sledges, five men, food for them for seventy-five days, instruments, tools, repair materials, lubricating oils, and 5,500 pounds of gasoline for the motors. It will be seen that in its cargo capacity our ship of the air, with its eight tons of carrying power, much more resembles a vessel to navigate the water than the small contrivances used by Santos-Dumont, Knabenshue, and Baldwin in aerial experimentation.

The instructions given by me to M. Godard, and embodied in the contract, were to spare neither weight nor expense in his efforts to make a balloon that should give the maximum of security and endurance. It is commonly believed among the aeronautic experts of France that the unfortunate Andree met his fate partly through faulty construction of his balloon; that it lacked the gas-tightness which should have enabled it to remain a long time in the air, and that the fabric of which it was composed did not possess sufficient tensile strength to enable it to resist the elements and give its navigators a fair chance for their lives. I pass no judgment as to this, because I believe the builder of Andree's balloon, who is now dead, was a careful and conscientious man. But, at any rate, I was determined to avoid such mistakes if care and prudence and outlay could suffice to do it. For in one particular, and in one only, speaking broadly, is our enterprise comparable to that of Andree—the solidity and endurance of the gas-bag is as essential to us as it was to him, despite the fact that his aerial craft was a mere toy of the winds, without motive power or steerability, while ours is to have both.

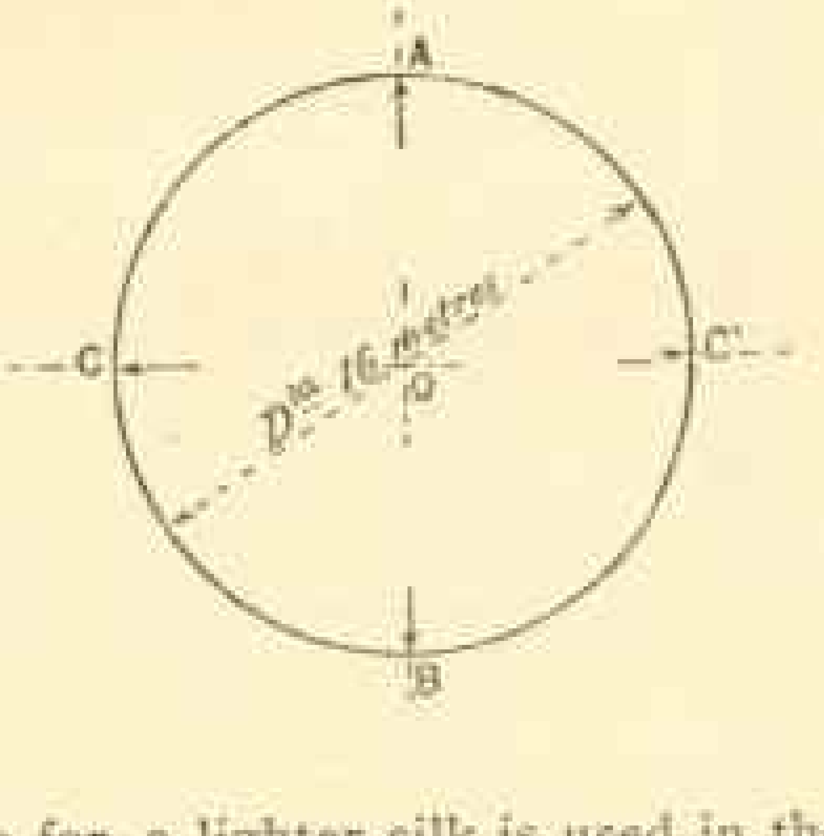
THE MATERIAL USED

In the past most balloons have been made of silk, varnished with from two to five coatings; but in recent constructions of important character cotton tissues have been employed, in one or more thicknesses, coated with a thin film of pure rubber applied by means of special machinery similar to the calenders of paper mills. The Lebaudy airship had two tissues of this cotton, both rubbered. After careful consideration and elaborate calculations of pressures and strains, three thicknesses of fabric were decided upon for our ship—two of cotton material and one of silk—with three coatings of rubber. All three are consolidated into one fabric, giving great tensile strength. Counting from the interior of the balloon, the envelope is made up as follows:

	Grammes per sq. meter.	Ounces per sq. foot.
Strong silk	85	.278
Caoutchouc (Para pure).....	105	.344
Cotton	105	.344
Caoutchouc	65	.213
Cotton	100	.328
Caoutchouc	45	.147
Total..................	505	1.654

In the central zone embracing the "maitre couple," or greatest diameter, the pressure of the gas rises to 466 kilos per square meter, equal to about 95 pounds per square foot. It is upon this central zone the envelope is applied as outlined above—one strong silk and two thicknesses of cotton, with three coats of rubber. These three thicknesses of material, consolidated into one, give a total tensile strength of 2,800 kilos per square meter, or about 575 pounds per square foot. Hence we have this result: Maximum strain, 95 pounds per square foot; tensile strength, 575 pounds per square foot; coefficient of safety, 6 to 1.

In the next zones the pressure ranges from 315 to 450 kilos per square meter. With a maximum of 450 kilos to provide for, a lighter silk is used in these zones, reducing the weight of the envelope to 455 grammes per square meter, but retaining 2,400 kilos of tensile strength, which means a coefficient of more than 5 to 1.



In the outer sections the maximum pressure is 350 kilos, and here the envelope is composed of two thicknesses of cotton with three coatings of rubber, omitting the silk, and again saving in weight, but securing 1,800 kilos of strength per square meter—again with a coefficient of safety of more than 5 to 1.

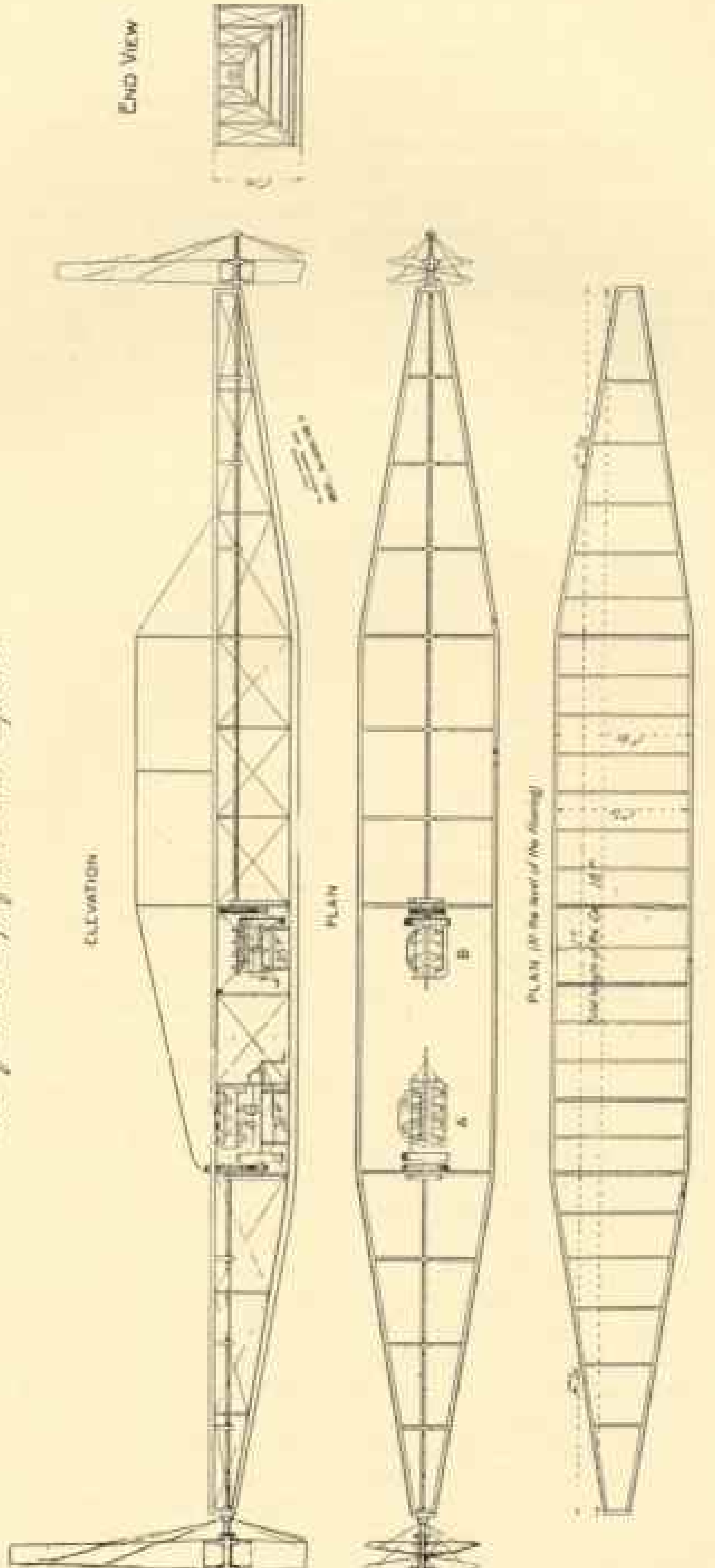
THE TENSILE STRENGTH

In the Lebaudy airship the coefficient of safety was 3½ to 1. We have a coefficient of more than 5 to 1 throughout.

The tensile strength of the fabrics is not a matter of guesswork. Samples of each consignment from the manufacturer are submitted to the Paris Chamber of Commerce, tested by dynamometer, and officially stamped. These tests are under the regulations of the chamber of commerce, and the certificates are made the bases of contracts and their fulfillment.

In computing the work of the gas upon the fabric of the balloon M. Godard and his engineers have assumed that the interior pressure is equivalent to 30 millimeters of water, or about 6 pounds per square foot. This pressure is maintained by means of the ventilator or blower which inflates with air the balloonet or interior balloon, and which is operated by an independent motor of 5 horsepower in the engine-room. The use of the pressure is to maintain the rigidity of form of the great balloon, as there are no interior frames or other stiffening devices. The integrity of form is maintained solely by interior pressure, and this pressure is usually at 20 to 24 millimeters. In taking 30 millimeters and adding it to the upward thrust or lifting force of the gas itself (somewhat more than one ounce per cubic foot), M. Godard has shown the conservatism which characterizes all his calculations and work. Though it is unlikely the interior pressure within our balloon will ever exceed 25 millimeters, the fabric of the envelope has strength sufficient to give a factor of safety of 5 to 1 at 30 millimeters.

In addition to the tensile strength of the envelope, every seam, whether circumferential or longitudinal, is reinforced. The material is lapped about 25 millimeters (one inch), and doubly sewn. Inasmuch as there is danger that the hydrogen may escape through



One of the fuselages of the Polar expedition the little holes made by the needle, all the sewing lines are covered with bands of fabric cemented to the envelope—first a band covering the seam, and over that still another and wider one. The primary purpose of these interior bands is to make the envelope as nearly as possible gas-tight, but they also add greatly to the tensile strength of the skin.

The outer surface of the balloon is quite smooth. There is no netting of cordage or of wires to hold moisture, snow, or frost. Besides, the outer surface is a coating of rubber, which will serve to shed the rain and snow and prevent moisture entering the fabric. In effect the double reinforcing bands which cover the seams, circumferentially and longitudinally, act as an interior netting, consolidated with the envelope, and increasing materially its powers of resistance to all stresses. This added tensile strength is not computed in the coefficient of 5 to 1.

No means has as yet been found of making, with fabrics, an absolutely gas-tight reservoir. In varnished silk balloons, even when of two or three thicknesses of material, the loss ranges from 1½ to 3 per cent daily. With fabrics coated with caoutchouc these losses are materially reduced; and with our threefold material and three coatings of rubber we shall, according to the experts, approximate very closely to gas-tightness. M. Godard's contract calls for an envelope from which the loss by leakage shall not exceed 1½ per cent in 24 hours, and he is convinced the loss will not be more than one-half of his maximum allowance. A loss of even 2 per cent per day would not be great enough to interfere with the plans of the expedition.

THE WEIGHT OF THE BALLOON

The weights of the various materials entering into the construction of the huge balloon will be approximately as follows:

	Pounds.
Fabric of the envelope, and rubber coatings	2,200
Reinforcing bands	225
Etraves and relingues (for suspension of car)	100
Five valves	110
Balloonet of light varnished silk	225
Total	2,860

Allowing for the three thicknesses, for the laps, and for wastage in cutting, approximately 12,000 square yards of fabric will be required. The cost of material is about $1.50 per yard as it comes from the factory.

It is the judgment of all the aeronautic engineers whom I consulted in Paris that M. Godard is constructing for our expedition the strongest and most enduring gas envelope known to the history of the art.

SPEED OF THE BIG AERONEF

When we start in our airship from Spitzbergen for the North Pole—and we entertain hopes of being able to set out in the latter part of next July or the early part of August—we expect to be able to advance at an average rate of about 12 geographical miles per hour; that is to say, this is the mean speed which has been assumed as the basis of our calculations. At one hour it may be greater, at another smaller; but this is the expected average. Of course, in speaking of the speed of a dirigible we always have in mind what the French call its "proper speed"—its speed of its own force in calms, the speed it could make wholly with its own means of propulsion, irrespective of the helping or the hindering of the winds. The effect of the wind upon the movement of an airship, whether in France, in America, or the Arctic regions, is precisely this: The velocity of the wind is to be subtracted from or added to the proper speed of the ship, according as whether the wind is adverse or favorable on the course one is sailing. For example, if an airship is steering northward, with a speed of 12 miles per hour, by its screws, and a south wind is blowing at 10 miles per hour, the speed of the ship, relative to the earth, will be 22 miles per hour. Conversely, in a north wind of 10 miles per hour, the ship will make but 2 miles per hour.

THE STEEL CAR

In the accompanying illustrations the reader will find the plans of the nacelle, or car, of our dirigible. It is a strong frame of steel tubing, and the end view shows the method of its construction on the truss principle. The length of this nacelle, or car, is 16 meters, or 52.5 feet; width, outside, 1m. .80, or 71 inches; width, inside, 1m. .70, or 67 inches.

The central section of the car is inclosed by means of walls and roof of fabric which is both water- and fireproof. The roof is 2 meters, or 78.5 inches, above the floor. The engine-room is 3 m. .50, or 11.5 feet, in length, and so is the cabin or living room of the crew, which is also to be used as a place to carry instruments and a part of the provisions. One disadvantage in the arrangement of the cabin is that the shaft for the rear propulseur passes directly through it; but it was desired to have all the motors in one engine-room, and hence it was not easy to make a better arrangement.

It will be noticed that the form of this steel car gives it the maximum of strength in proportion to its weight, and that the helices, or propulseurs, and their shafts are emplaced in a staunch manner. The total weight of the steel car, with the inclosure, but without the motors, shafts, screws, or any other machinery, is 330 kilos, or 730 pounds.

One of the most important questions that had to be decided was the power and number of the motors. Should we go in for high speed, or content ourselves with lower speed secured with a relatively smaller expenditure of fuel?

Obviously this involved the whole question of the plan of the campaign, and the conclusion reached might be decisive of the success or failure of the expedition. So it may be easily understood that many days and nights of anxious study were given to this fundamental problem.

NAVIGATING AGAINST THE WINDS

In determination of this problem of the speed the first question that arose was: "Is it practicable to give the airship high enough speed of its own power to enable it to make headway against any winds it is likely to encounter during its voyage to the Pole and back?"

If this question could be answered in the affirmative—we mean in a practical, not merely a theoretical, sense—then manifestly this would be the better method to employ. It would be fine indeed to have at one's command a ship of the air, like a steamship of the ocean, that need not stop its course for any wind that might blow along its course, whether favorable or unfavorable. Obviously the velocities of the winds in the Arctic Ocean in July and August are the criteria to which this phase of the problem must be first referred. Fortunately I had made elaborate studies and analyses of the Arctic winds. From the observations made by the Dr Nansen Expedition in the *Fram* during three years of drift through the North Polar Sea, I had deduced the probabilities of winds for given periods. Turning to these tables of wind means or general probabilities, we found that if the voyage of an aerial craft were to cover a period of 10 days we might expect to encounter winds as follows:

Under 10 miles per hour—140 hours.

From 10 to 17 miles per hour—80 hours.

From 17 to 30 miles per hour—20 hours.

If we could equip ourselves with motors and screws able to secure 17 miles per hour, we should be able to make headway against about eleven-twelfths of all the winds we should expect, from the means of probability, to encounter.

To be able to meet and overcome all winds, we should have to be equipped with motors and screws giving at least 30 miles per hour.

Was this last-named speed attainable? Theoretically, yes; practically, no. I shall try in a few words to make the answer plain. Resistance of a body moving through the air increases, as we all know, not with the speed, but with the square of the added velocity. I took the best formula—that of the late Colonel Renard, whose brother, Commandant Renard, was one of my valued counselors. I compared the formula with the actual experiences of La France, the Lebaudy, the Santos-Dumont and other successful airships. I found that for a speed of 10 geographical miles per hour we should need about 20 horsepower; for 12 miles per hour, about 40 horsepower; for 17 miles per hour, about 75 horsepower; but that for 30 miles per hour at least 400 horsepower would be required.

Now, it would be possible to put motors of 400 horsepower into our airship. We have at our disposal for machinery, cargo, fuel, and crew about 8,500 pounds. Motors can be built at about 7.5 pounds per horsepower; hence we should have to put at least 3,000 pounds of our weight into motors. The crew, provisions, instruments, etc., must weigh 3,000 pounds, and at the utmost 2,500 pounds would be left for gasoline. As each horsepower hour represents a consumption of 0.7 pound of gasoline, or about 0.85 pound, including the reservoirs and the lubrication, every hour the 400 horsepower motor was worked would cost about 350 pounds in fuel and other weight. For that 350 pounds we should gain 30 miles, or nearly 12 pounds per mile. The distance to the Pole and return being about 1,200 miles, this plan would call for about 14,000 pounds of gasoline, and then we should have no margin over the actual distance in a straight line from Spitzbergen to the Pole and back again.

True, we might build a larger airship. But the larger the ship, the more resistance to be overcome. It might be possible, by constructing an airship five times larger than ours, at a cost of a million dollars, to secure a speed of 25 to 30 miles per hour, and fuel capacity sufficient to voyage to the Pole and return; but I doubt it. At any rate, such speeds are wholly impracticable in our venture. And, fortunately, they are not required for a successful outcome.

One of the ablest of the aeronautic engineers of Paris came to see me, after my decision as to speed and method had been announced in the French newspapers.

"Your plan is all wrong," he declared; "I have come to tell you that you will surely fail if you adhere to that method."

"What do you recommend?" I asked.

"High speed—go quickly as possible—leave all contact with the earth by means of the guide-rope—sail high in the air, and make a fast voyage up and back."

"At what speed?"

"You should make at least 15 meters per second with your motors—55 kilometers per hour."

I asked my friend to sit down and figure out the weight of the motors that would be required to yield this speed, equal to about 30 geographical miles per hour, and the amount of fuel that would be required, remarking that I was afraid he had not sat up nights with the problem as much as I had, and at the same time handing him my computations. He ran over them, saw that they were approximately correct, and, like a gentleman, acknowledged his mistake, saying, "You are right, and I was wrong."

Having reached the conclusion that speeds of 25 to 30 miles per hour were impracticable and unnecessary, there arose the secondary question, What is the highest speed we shall try for? This was involved, also, in the question of the number of motors, their horsepower, and the number and emplacement of the helices or screws.

THE MOTORS AND ENGINES

From the first I was determined not to attempt the voyage with a single motor, though that would represent the greatest economy of weight in relation to efficiency. If we carried but a single motor, and that were to break down, we should be left helpless. Thenceforth we could only drift with the wind, as the brave but unfortunate Andree did in his balloon. Santos-Dumont, who has been so helpful with counsel out of his store of experience that I owe him a large debt of gratitude, advised me to take four motors, each of 25 horsepower, working one, two, three, or four, according to circumstances and needs. But my choice, after long consideration, fell on two motors, one of 50 horsepower and the other of 25, with a smaller one of 5 horsepower to work the ventilator which inflates the balloonet. Engineers Godard, Andre, Hervieu, Liventaal (all associated with the expedition as contractors or as employees) and other experts indorsed my decision.

If one motor were to break down in the field we have another in reserve. If we need full speed we can work both motors together. If a less speed is considered sufficient for the hour, we can use the 50 horsepower motor alone. If the circumstances justify a still smaller rate of progress (and greater economy of fuel in proportion to the distance covered), the 25 horsepower motor may be worked while the larger one is idle.

In case of breakage of one of the motors beyond repair (we shall carry tools and a small machine shop, prepared to make all ordinary repairs in the field), the permanently disabled motor may be thrown overboard, lightening ship.

Another advantage of having two engines and two screws is that while the best of the modern inner combustion motors may be prudently worked many hours without stopping, it is our purpose to take no risks of overheating through too long continuous running, but to stop each motor once in three or four hours for inspection and cooling. While one is idle the other may be worked.

Again, I stipulated in the contract that for the principal or larger propulseur and its shaft we should have reserve parts—another screw and another shaft, all so arranged that in case of accident to one it may be taken out and thrown away and the reserve be fitted in its place. Hence we have in our motive department two motors and three screws and shafts, all of which must be permanently disabled before our navigating power comes to an end.

Considering the average, 12 geographical miles per hour is the speed we expect to attain. This should be secured with an average of about 40 horsepower in operation. It is true that we shall never positively and accurately know what speeds we are to attain until we have the trials of our airship, and these trials we hope to have in Spitzbergen next July. But the contract with Constructor Godard calls for the following efficiencies of the motors:

Motor in operation.	Propulseur.	Meters per second.	Kilom. per hour.	Statute miles per hour	Geographical miles per hour.
50 H. P.	Large.	6.67	24	14.91	12.94
25 H. P.	Small.	4.72	17	10.56	9.17
75 H. P.	Both.	8.88	32	19.88	17.27

M. Godard has no doubt we shall be able to realize these speeds. It is not my proper function to pass judgment, but to go into the field and learn through actual trials how well he has worked up to his contract obligations. M. Godard is a conservative, careful man, and I have much faith in him.

With proper speeds of from 9 to 17 geographical miles per hour at our command, we shall be able to cope with approximately eleven-twelfths, certainly four-fifths, of all the winds that blow over the Arctic Ocean in July or August.

And what are we to do when stronger winds blow? That is another story.

PROTECTION DURING STORMS

With unfavorable winds of higher velocities we shall stop the motors and throw out upon the ice-sheet over which we are sailing a dragging anchor or retardateur—a device calculated to offer the maximum of resistance in proportion to its weight—and by this means to drift slowly with the adverse wind.

Assuming that this method works out as well in practice as in theory—and there are many reasons for believing that it will do so to at least a fair degree—we have then this principle:

1. All the winds that blow with our course, directly or obliquely, add their movement to the advance which we expect to make with our motors and help us so much on our way.

2. But contrary winds of velocities greater than our motor speed, or so great that motoring against them would be an uneconomical use of fuel, are not losses to be deducted at full value from the progress of the airship, because the influence of such winds is largely neutralized by the action of the dragging anchor or retardateur.

In other words, *all* of the value of favorable winds is placed on the credit side of our ledger or log, while only *a part* of the value of the unfavorable winds has to be written down on the debit side.

And the significance of this, in the last analysis, is that it will require a most extraordinary combination of circumstances to prevent us getting more help than hindrance from the winds.

Before I went to Paris to make a complete study of the problem from the standpoint of practical aeronautics, it was a part of the plan to motor in favorable winds or adverse but light winds, and in case of winds both adverse and of relatively high velocity to anchor firmly to the ice by means of grappling irons and steel cables. Eminent aeronautic engineers had said this could be done with safety. They pointed to the fact that the Lebaudy ship had been several times thus firmly anchored to the earth, riding out rather severe squalls.

But this method was condemned by a majority of the practical men who were consulted. Their objection was usually expressed in language like this:

"Yes, you can undoubtedly make firm and safe anchorage in winds of 10, 15, 20 perhaps 25 miles per hour. You can calculate the resistance which your ship will offer to such winds, and put the necessary strength into your anchors, cables, suspensions, and envelope. But supposing that while you are anchored with devices made to stand, say, 25 miles per hour the wind should suddenly freshen to 35 or 45 miles per hour. That would produce a vast increase of the stress upon all your tackle, for the augmentation of pull would be, not simply in proportion to the speed of the wind, but as the square of the added velocity. Your tackle might break, or the form of your balloon might be collapsed by the pressure. If the balloon were to lose the rigidity and symmetry of its form the wind would exert still greater force upon its flattened surface; and that might spell disaster."

Others urged that were a gale of wind to attack the anchored ship the enormous pressure would force the balloon down toward the ice, and might even thrust it, or its suspended car, upon the surface of the ice-sheet with such violence as to wreck the whole affair. They pointed out that the effect of the wind upon the airship in such case would be something like that shown diagrammatically in Figure 1.

In a calm the anchored dirigible would stand as at A. In a wind of 25 miles per hour, for example, it would be forced to a position as at B. With a wind of 35 miles per hour or upward it would be thrust down to C.

They admitted, it is true, that with compensating weights—such as heavy guide-rope equilebreurs, suspended below the ship, and so disposed that they could come in contact with the ice without injury—there must come an angle, no matter how great the power of the wind, when the downward thrust of its pressure would be offset by the ascending power of the balloon, thus relieved of a considerable part of its weight. But even then there would be the hazard of disaster due to pounding, to plunging up and down with the fluctuating force of the wind, and to the other causes already spoken of.

For reasons which have been already pointed out, it was, in my opinion, imperative that the plan of retaining contact with the surface of the earth through the guide-rope equilebreur, and occasionally by anchorage, should be adhered to.

We shall not attempt to make firm anchorage, save in calms or very light airs, and then only for special purposes, such as scientific observations. In lieu thereof we shall employ the principle of the dragging anchor. When adverse winds of relatively high velocity are encountered, instead of throwing out a grappling hook we shall let trail over the ice a steel cable provided with small projections, like hooks or rings, calculated to give a resistance equal to the pull of the airship in a wind of about 12 to 15 miles per hour. That will mean about 250 kilogrammes of resistance, and it should be secured with a cable weighing about 300 kilos, perhaps less. The surface of the ice offers almost ideal facilities for the operation of such a device, and it is perhaps the only place in the world where this method could be successfully employed over a wide area.

If we arrange our retardateur for working up to, say, 12 miles per hour, with ample margin of strength in all parts, we shall know that this is approximately the maximum stress that can ever be put upon it. There will be no danger of the work being quadrupled by an increase of the velocity of the wind up to 30 or 40 miles per hour.

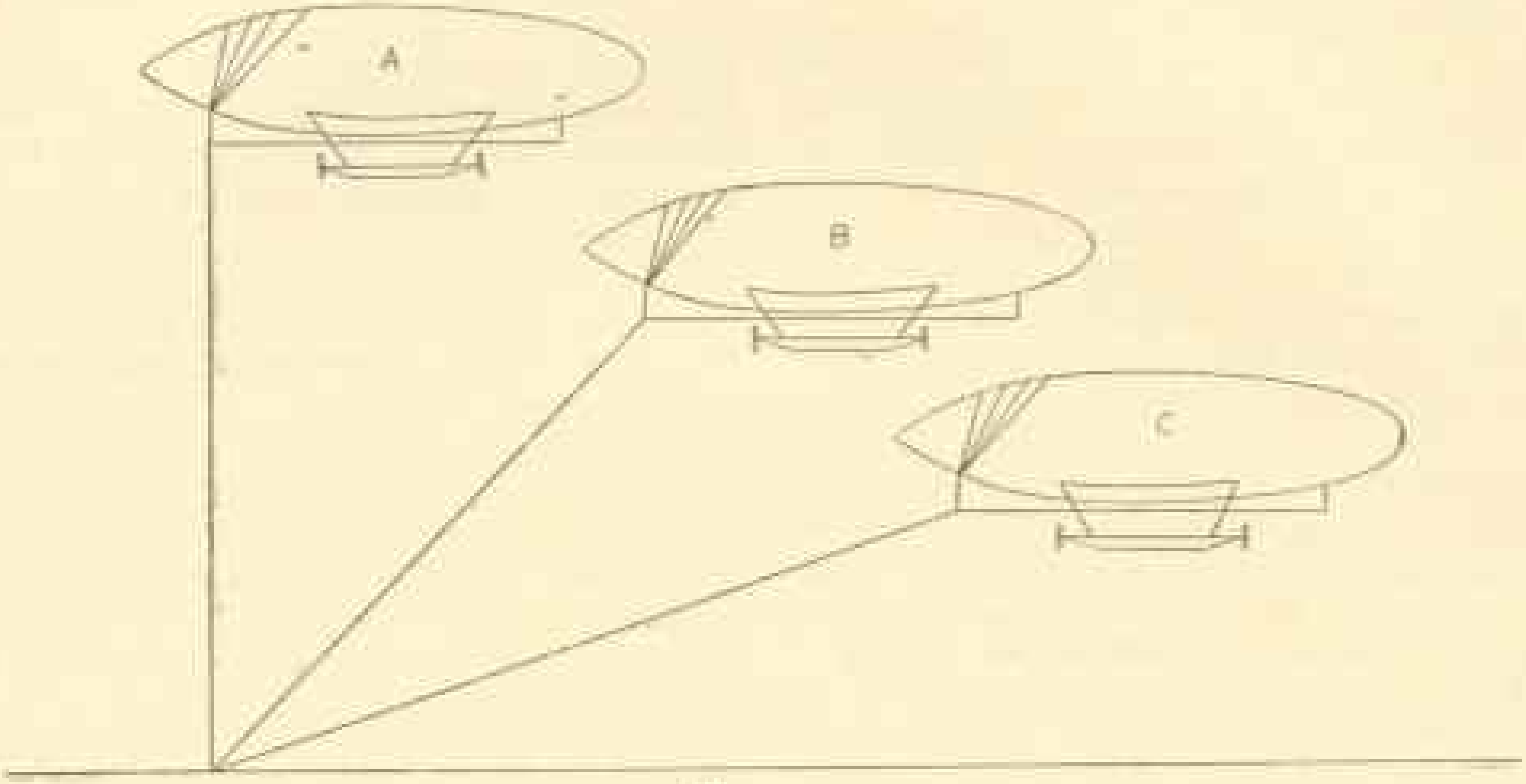


Figure 2.

With a wind of 10 to 12 miles per hour we shall remain approximately stationary in the air, perhaps drifting half a mile or a mile per hour. In a wind of 15 miles per hour we should drift about 3 miles per hour with it. In a wind of 20 miles per hour the driftage should be 8 miles per hour. Should the wind rise to 30 miles per hour the driftage should be about 18 miles per hour. Thus in the higher winds we should lose way according to the velocity, but in no case would we incur risks of rupture of our apparatus by having it subjected to strains greater than it is able to withstand. The maximum strain provided for can never be exceeded, no matter what the force of the wind. The balloon can never be subjected to the stress, the pounding, the violent vertical plunging such as would occur in firm anchorage, where there must be a constant effort on the part of the aeronef to find adjustment between the two forces—one a horizontal pull, the other the lifting power of the balloon. There would be no danger of being thrust down near to or into contact with the ice. All strains would be cushioned, yielding, "giving," with the driftage of the vessel.

It is not necessary to go into details concerning the mechanical aspects of the retardateur. In fact, several methods of securing resistance will be tested at Spitzbergen, and the one which gives best results will be finally chosen.

An important consideration is the method of operating the retardateur; also its point of suspension. If it were payed out from a windlass in the open boat below the car, as we had at first planned, the result would be that the angle of its pull would run according to the line A-B-C in this diagram.

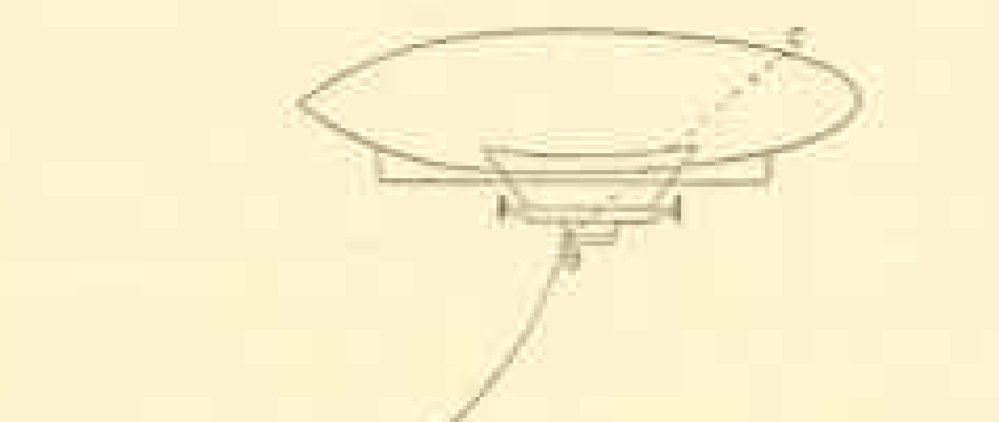


Figure 2.

In other words, the pull of the drag-anchor on the ice at A would be transmitted through the steel boat at B to the rear end of the balloon at C. The airship would be turned round. Its stern instead of its prow would be presented to the wind. After full discussion of this subject with M. Santos-Dumont, who has had more experience in guide-roping and similar work than any one else, and who gave us the full benefit of his practical knowledge, it was decided to adopt the method of suspension and operation shown in figure 3.

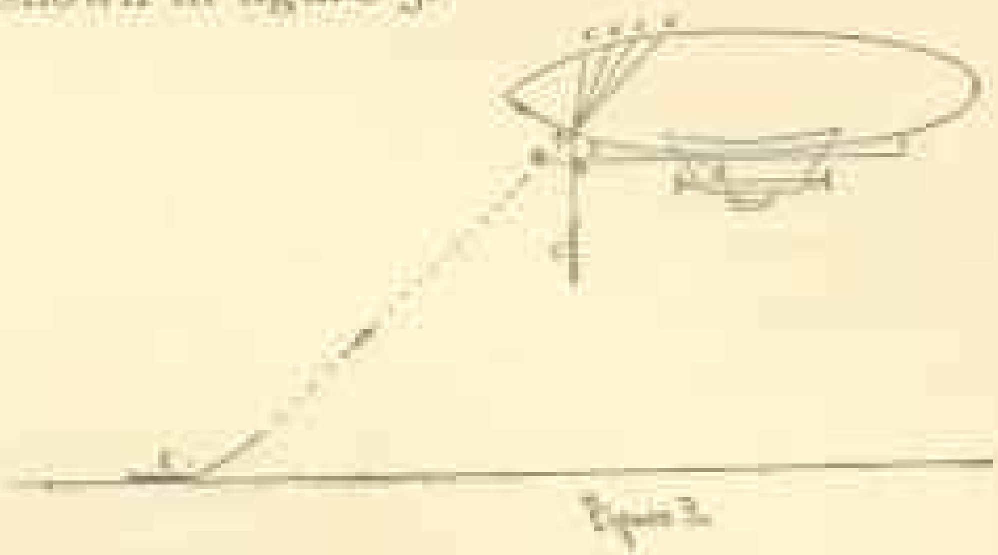


Figure 3.

The retardateur cable is suspended from the prow of the balloon at A, from which point bands of fabric of high tensile strength are passed over the body of the aeronef—A- A′ A′ A′ A′—to distribute the stress.

When the retardateur is not in use it hangs from its operating pulley, B, free from contact with the ice, and out of the way of any possible interference with the forward screw. When it is desired to put it to work it is lowered by means of the line D D D working over pulleys down to a windlass in the steel boat. The moment it strikes the ice and the aeronef drifts backward, the angle of the retardateur cable follows the dotted line. All the pull of the drag-anchor at E is thus exerted upon the forward part of the balloon, and the aeronef always keeps its prow to the wind. If the wind shifts, the balloon turns with it like a weather-vane.

When the wind moderates and the use of the retardateur is no longer needed, and the motors are started, the cable is pulled in by the windlass till it once more hangs vertically at C.

This is the method we have adopted for minimizing the driftage in strong adverse winds—the method which we believe will enable us to take full credit value from all favorable winds and to cut down materially without expenditure of fuel the losses inevitably incident to unfavorable winds.

Mr Wellman realizes the fact that the winds which he will experience will have much to do in making his expedition a success or failure. He has therefore made a very careful examination of the winds during July and August at Spitzbergen, as recorded by the *Fram* parties. A number of the wind tables so prepared by him are given in the following pages:

WIND FREQUENCY IN THE ARCTIC OCEAN

The following table, condensed from the compilations of Professor Mohn, editor of the meteorological volumes of "Scientific Results of the Norwegian Polar Expedition," gives the "averages per mille," or frequency of the winds from the various quadrants of the compass, per thousand observations:

	Southerly Winds, Observations.	Northerly Winds, Observations.	Easterly Winds, Observations.	Westerly Winds, Observations.	Calms, Observations.
July, 1894	347	426	0	189	38
" 1895	520	353	24	97	6
" 1896	711	221	29	39	....
Mean	526	333	18	108	14
Aug., 1894	381	394	43	106	76
" 1895	470	349	91	78	12
" 1896	358	513	51	78	....
Mean	403	419	62	87	29
Mean 2 years	464.5	376	40	97.5	22

WIND FREQUENCY AND DIRECTION BY TEN-DAY PERIODS

(From *Fram* Records)

The table shows the number of hours of wind from each quadrant of the compass, and calms.

Periods	S.W.	S.E.	N.E.	N.W.	Calm.	Total hours.
A July 15–July 24, 1894	68	44	34	80	14	240
B " " " " 1895	10	0	126	102	2	240
C " " " " 1896	68	44	38	82	8	240
D July 25–Aug. 3, 1894	94	0	0	146	0	240
E " " " " 1895	176	46	18	0	0	240
F " " " " 1896	38	42	92	48	20	240
G Aug. 4–Aug. 13, 1894	114	6	34	54	32	240
H " " " " 1895	40	20	2	164	14	240
Mean	76	25.25	43	84.5	11.25	240

WIND FREQUENCY, DIRECTION, AND VELOCITY BY TEN-DAY PERIODS

		S.W.	S.E.	N.E.	N.W.	Calm.	Total.
A	Hours	68	44	34	80	14	240
	Mean miles per hour	7.6	8	7	9.3	...	7.7
	Total miles	516	352	238	744	...	1,850
B	Hours	10	...	126	102	2	240
	Mean miles per hour	6.5	...	7.7	7.5	...	7.5
	Total miles	65	...	970	765	...	1,800
C	Hours	68	44	38	82	8	240
	Mean miles per hour	6.4	5.8	7.75	11.85	...	8.16
	Total miles	435	255	295	975	...	1,960
D	Hours	94	...	...	146	...	240
	Mean miles per hour	7.75	...	...	9	...	8.5
	Total miles	730	...	...	1,315	...	2,045
E	Hours	176	46	18	...	...	240
	Mean miles per hour	14	10	13.2	...	...	13.2
	Total miles	2,465	460	240	...	...	3,165
F	Hours	38	42	92	48	20	240
	Mean miles per hour	6.5	3.8	7.75	7.4	...	6.4
	Total miles	245	160	715	355	...	1,475
G	Hours	114	6	34	54	32	240
	Mean miles per hour	5.5	3.5	5.75	5.5	...	5.53
	Total miles	630	20	200	300	...	1,150
H	Hours	40	20	2	164	14	240
	Mean miles per hour	6	8.5	7.5	7	...	6.94
	Total miles	240	170	15	1,150	...	1,575
Total	Hours	76	25.25	43	84.50	11.25	240
	Miles per hour	8.78	7.07	7.77	8.29	...	7.83
	Miles	667	178	334	700	...	1,879

Mr Wellman has assumed 10 days as the approximate duration of his aerial voyage. From the foregoing records of the actual winds (*Fram*) prevailing in eight such periods in July or August, it will be seen that the number of miles of wind-movement divided between north and south is as follows:

	South.	North.		South.	North.
A	868	982	E	2,925	240
B	65	1,735	F	405	1,070
C	690	1,270	G	650	500
D	730	1,315	H	410	1,165

In only two of the eight periods is there a very great preponderance of winds from one direction over those of the other. One of these has a southerly resultant, the other a northerly.

The mean of the eight periods is: South, 845 miles; north, 1,034 miles.

WIND VELOCITIES IN THE ARCTIC OCEAN IN JULY AND AUGUST BY TEN-DAY PERIODS, GENERAL MEAN, AND ACTUAL, FROM *FRAM* RECORDS IN GEOGRAPHICAL MILES,

WITH CURVES SHOWING THE MEAN AND MAXIMUM VELOCITIES PER PERIOD FOR 100 HOURS OR 140 HOURS, STARTING FROM CALMS

As we have already seen, the navigating method adopted and the supply of fuel carried admit of from 100 to 140 hours of work by the motors, according to the average horsepower employed.

It was important to know, as accurately as possible, what velocities of wind might be expected in a voyage assumed, in order to have a basis of computation, at 10 days' duration.

Hence this Synoptic Table was compiled from thousands of actual observations, showing, first (O) the general mean in July and August, and, second (A, B, C, etc.), the actual winds which prevailed in 14 10-day periods, selected arbitrarily, without reference to whether they would yield favorable or unfavorable results.

Upon this table are drawn two curves—one of 100 hours of motoring, the other 140 hours of motoring. The motoring, naturally, will be, generally speaking, in calms or the winds of smaller velocity. The table being arranged cumulatively, the mean and maximum velocity of the wind is shown at a glance for any given number of hours, starting at calms.

For example, following the 100-hour motor-curve, it is found that in the period of 10 days "O"—general mean—it cuts about halfway between 7 and 8 miles per hour. Hence the maximum wind for this period, with 100 hours of motoring, is 7.5 miles per hour, and the mean for the 100 hours (falling half way between the total miles per hour for 7 and 8) is taken at 5.6 miles per hour. In period A (actual *Fram* observations) the 100 hours of motoring is secured with a maximum wind velocity of a little over 7 miles per hour and a mean of 5.5. In B period the maximum is 7, the mean 6.35, and so on.

O=the mean of the *Fram* observations during three Julys and two Augusts, with 15 per cent added to allow for greater velocities 100 to 300 feet above the surface of the earth.

A, B, C, etc.=actual winds by 10-day periods, arbitrarily selected, to show how much divergence there is in any given 10-day period from the grand mean comprising 155 days.

For each period the first gives the number of hours of wind at the velocity in miles per hour noted at the top of the table; the second line gives the number of miles of wind movement at that velocity; the third, fourth, and fifth lines are cumulative from calms upward. For example, in A, at and including 7 miles per hour, there is a total of 96 hours of wind at that or lesser velocity, with a total wind movement of 520 miles and a mean of 5.41 miles per hour; including 8 miles per hour, there are 136 hours, a total of 840 miles, and a mean of 6.2 miles per hour, etc.

The totals and means for each period are found in the last column at the right. The mean of 14 10-day periods is found at the bottom of the table, marked "Totals." The last line of all is the grand mean miles per hour of 155 days for comparison with the mean miles per hour of the 14 10-day periods in the line just above.

100-HOUR CURVE   150-HOUR CURVE

	Miles per hour	1	4	6	7	8	9	11	12.5	15	18	25
O	Hours of wind	10	15	40	25	25	25	25	30	25	15	5
	Miles of wind	10	60	240	175	200	225	275	375	375	270	125
	Total hours	10	25	65	90	115	140	165	195	220	235	240
	Total miles	10	70	310	485	685	910	1,185	1,560	1,935	2,205	2,330
	Miles per hour	1	2.8	4.77	5.4	6	6.5	7.18	8	8.5	9.4	9.7
A	Hours	16	6	34	40	40	21	21	36	24	2	0
	Miles	16	24	204	280	320	189	231	450	360	36	......
	Total hours	16	22	56	96	136	157	178	214	238	240	......
	Total miles	16	40	244	520	840	1,029	1,260	1,710	2,070	2,106	......
	Miles per hour	1	1.82	4.36	5.41	6.2	6.55	7.1	8	8.7	8.8	......
B	Hours	0	4	50	45	45	36	36	18	6	0	0
	Miles	0	16	300	315	360	324	396	225	90	......	......
	Total hours	0	4	54	99	144	180	216	234	240	......	......
	Total miles	0	16	316	631	991	1,315	1,711	1,936	2,026	......	......
	Miles per hour	0	4	5.85	6.36	6.88	7.3	8	8.27	8.45	......	......
C	Hours	12	24	46	26	26	13	13	34	26	20	0
	Miles	12	96	276	182	208	117	143	425	390	360	......
	Total hours	12	36	82	108	134	147	160	194	220	240	......
	Total miles	12	108	384	566	774	891	1,034	1,459	1,849	2,209	......
	Miles per hour	1	3	4.68	5.25	5.75	6	6.46	7.52	8.4	9.2	......
D	Hours	0	6	24	37	37	39	39	40	16	2	2
	Miles	0	24	144	259	296	351	429	500	240	36	......
	Total hours	0	6	30	67	104	143	182	222	238	240	......
	Total miles	0	24	168	427	723	1,074	1,503	2,003	2,243	2,279	......
	Miles per hour	0	4	5.6	6.38	7	7.5	8.26	9.02	9.42	9.5	......
E	Hours	0	2	6	5	5	19	19	20	68	74	22
	Miles	0	8	36	35	40	171	209	250	1,020	1,332	550
	Total hours	0	2	8	13	18	37	56	76	144	218	240
	Total miles	0	8	44	79	119	290	499	749	1,769	3,101	3,651
	Miles per hour	0	4	5.5	6	6.6	7.84	8.9	9.85	12.3	14.23	15.2
F	Hours	28	40	56	26	26	14	14	20	4	12	0
	Miles	28	160	336	182	208	126	154	250	60	216	......
	Total hours	28	68	124	150	176	190	204	224	228	240	......
	Total miles	28	188	524	706	914	1,040	1,194	1,444	1,504	1,716	......
	Miles per hour	1	2.76	4.23	4.7	5.2	5.5	5.85	6.43	6.6	7.15	......
G	Hours	22	42	110	20	20	10	10	6	0	0	0
	Miles	22	168	660	140	160	90	110	75	0	0	......
	Total hours	22	64	174	194	214	224	234	240	0	0	......
	Total miles	22	190	850	990	1,150	1,240	1,350	1,425	0	0	......
	Miles per hour	1	3	4.9	5.1	5.38	5.54	5.77	5.94	0	0	......
H	Hours	14	6	64	43	43	32	32	4	2	0	0
	Miles	14	24	384	301	344	288	352	50	30	0	......
	Total hours	14	20	84	127	170	202	234	238	240	0	......
	Total miles	14	38	422	723	1,067	1,355	1,707	1,757	1,787	0	......
	Miles per hour	1	1.9	5	5.7	6.3	6.7	7.3	7.4	7.45	0	......
I	Hours	0	0	12	42	42	44	44	44	10	2	0
	Miles	0	0	72	294	336	396	484	550	150	36	......
	Total hours	0	0	12	54	96	140	184	228	238	240	......
	Total miles	0	0	72	366	702	1,098	1,582	2,132	2,282	2,318	......
	Miles per hour	0	0	6	6.8	7.3	7.8	8.6	9.35	9.6	9.7	......
J	Hours	0	4	18	11	11	22	22	22	56	56	18
	Miles	0	16	108	77	88	198	242	275	840	1,008	450
	Total hours	0	4	22	33	44	66	88	110	166	222	240
	Total miles	0	16	124	201	289	487	729	1,004	1,844	2,852	3,302
	Miles per hour	0	4	5.6	6.09	6.57	7.38	8.28	9	11.11	12.85	13.75
K	Hours	24	36	50	20	20	13	13	28	16	20	0
	Miles	24	144	300	140	160	117	143	350	240	360	......
	Total hours	24	60	110	130	150	163	176	204	220	240	......
	Total miles	24	168	468	608	768	885	1,028	1,378	1,618	1,978	......
	Miles per hour	1	2.8	4.25	4.68	5.12	5.43	5.85	6.75	7.35	8.25	......
L	Hours	18	36	98	20	20	17	17	8	6	0	0
	Miles	18	144	588	140	160	153	187	100	90	0	......
	Total hours	18	54	152	172	192	209	226	234	240	0	......
	Total miles	18	162	750	890	1,050	1,203	1,390	1,490	1,580	0	......
	Miles per hour	1	3	5	5.17	5.47	5.75	6.15	6.35	6.6	0	......
M	Hours	6	2	50	25	25	41	41	4	26	20	0
	Miles	6	8	300	175	200	369	451	50	390	360	......
	Total hours	6	8	58	83	108	149	190	194	220	240	......
	Total miles	6	14	314	489	689	1,058	1,509	1,559	1,949	2,309	......
	Miles per hour	1	1.75	5.4	5.9	6.4	7.1	7.94	8	8.86	9.62	......
N	Hours	4	28	48	24	24	15	15	8	36	38	0
	Miles	4	112	288	168	192	135	165	100	540	624	......
	Total hours	4	32	80	104	128	143	158	166	202	240	......
	Total miles	4	116	404	572	764	899	1,064	1,164	1,704	2,328	......
	Miles per hour	1	3.62	5.05	5.5	6	6.3	6.75	7	8.4	9.7	......
Totals	Hours	10.4	17.4	47.5	27.4	27.4	24	24	21	21.1	15.6	3.2
	Miles	10.4	69.6	285	190	220	216	264	262	320	315	80
	Total hours	10.4	27.8	75	102	130	154	178	199	220	233	240
	Total miles	10.4	80	365	555	775	991	1,255	1,519	1,839	2,154	2,232
	Miles per hour	1	2.87	4.86	5.43	6	6.43	7	7.63	8.36	9.09	9.30
O	Total miles per hour	1	2.8	4.77	5.4	6	6.5	7.18	8	8.5	9.4	9.7

In the following interesting tables Mr Wellman has worked out his northing by the navigating method already described by him in the context, for each of the 10-day periods covered by the Synoptic Table, on the basis of 12 miles per hour motoring, for 140 hours, and retardation of 12 miles per hour during 100 hours of drifting, save that in drifting with the lighter winds—12.5, 11, 9, or even fewer miles per hour—the loss is assumed at 1 mile per hour in each case.

The first table shows what might be accomplished with *all* the winds throughout the various periods *directly contrary to the course*. In two cases there would be no progress at all, on account of the velocity of the contrary winds, but in all the others the voyage would continue past, to, or near to the Pole.

EXPERIENCE WITH ALL WINDS ASSUMED AS DIRECTLY UNFAVORABLE TO THE COURSE

Motor period, 140 hours, 12 miles per hour. 1,680 miles.		Drifting period.......... 100 hours. Maximum retardation.......... 12 miles per hour.								
Mean wind. Miles per hour.	Motor gain over wind. Miles.	Wind, miles per hour..... Drift, miles per hour.........	*9 1	11 1	12.5 1	15 3	18 6	25 13	Total Loss.	Net Gain.
O 6.50....	770	Hours	0	25	30	25	15	5		
		Miles lost.....	0	25	30	75	90	65	285	485
A 6.25.....	805	Hours	17	21	36	24	2	0		
		Loss	17	21	36	72	12	..	158	647
B 6.85.....	720	Hours	40	36	18	6	..	..		
		Loss	40	36	18	18	..	..	112	608
C 6.00.....	840	Hours	7	13	34	26	20	..		
		Loss..........	7	13	34	78	120	..	252	588
D 7.50.....	630	Hours	3	39	40	16	2	..		
		Loss	3	39	40	48	12	..	142	488
E 12.25.....	—35	Hours	..	..	..	4	71	22		
		Loss...........	..	..	..	12	444	286	742	—777
F 4.50... ..	1,050	Hours	50	14	20	4	12	..		
		Loss..........	50	14	20	12	72	..	165	885
G 4.25.....	1,085	Hours	84	10	6	..	..	..		
		Loss	84	10	6	..	..	..	100	985
H 5.75.....	895	Hours	62	32	4	2	..	..		
		Loss..........	62	32	4	6	..	..	104	791
I 7.90.....	575	Hours	..	44	44	10	2	..		
		Loss....	..	44	44	30	12	..	130	445
J 10.00.....	280	Hours	..	..	..	26	56	18		
		Loss	..	..	..	78	336	234	648	—368
K 5.00.....	980	Hours	23	13	28	16	20	..		
		Loss	23	13	28	48	120	..	232	748
L 4.75.....	1,015	Hours	69	17	8	6	..	..		
		Loss...........	69	17	8	18	..	..	112	903
M 7.00. ...	700	Hours ...	9	41	4	26	20	..		
		Loss	9	41	4	78	120	..	252	448
N 6.25.....	805	Hours	3	15	8	36	38	..		
		Loss	3	15	8	108	228	..	362	443
Mean of the 14 10-day periods..........										490

*Included with 9 miles per hour are in some cases winds of 8, 7, or 6 miles per hour.

EXPERIENCE WITH ALL WINDS OF THE RETARDING PERIOD ASSUMED AS DIRECTLY ADVERSE AND MOTORING PERIOD DIVIDED AS FOLLOWS:

	Drifting period, all winds adverse, 100 hours.	Motoring period, 140 hours; motor distance, 1,680 miles; winds, 30 hours favorable, 110 hours unfavorable, at mean velocity.					
			Unfavorable, 110 hours.		Favorable, 30 hours.		Motor, 1,680 miles.
	Loss miles	Mean miles per hour.	Miles.	Total loss.	Miles.	Net loss.	Net gain.
O	285	6.73	715	1,000	195	805	875
A	158	6 25	962	850	190	660	1,020
B	112	6.85	753	865	205	660	1,020
C	252	6.00	660	910	180	730	950
D	142	7 50	825	965	245	720	960
E	742	12.25	1,350	2,090	365	1,725	—45
F	165	4.50	495	660	135	525	1,155
G	100	4 25	470	570	130	440	1,240
H	104	5 75	636	740	170	570	1,110
I	130	7 90	870	1,000	240	760	920
J	648	10.00	1,100	1,650	300	1,350	330
K	232	5.00	550	780	150	630	1,050
L	112	4.75	523	635	145	490	1,190
M	252	7 00	770	1,020	210	810	870
N	362	6.25	688	1,050	190	860	820
		Mean of the 14 10-day periods					900

EXPERIENCES WITH ALL DRIFTING WINDS ASSUMED DIRECTLY ADVERSE AND VARIOUS PERCENTAGES OF FAVORABLE AND UNFAVORABLE IN THE MOTOR-PERIOD

Taking the losses in the 100-hour drift-period from the preceding tables and estimating higher percentages of favorable winds in the 140-hour motor-period, we get results as follows:

	AA. Favorable, 40 hours. Unfavorable, 100 hours. Net gain in 10 days.	BB. Favorable, 50 hours. Unfavorable, 90 hours. Net gain in 10 days.	CC. Favorable, 70 hours. Unfavorable, 70 hours. Net gain in 10 days.
	Miles.	*Miles.*	*Miles.*
O	1,005	1,135	1,395
A	1,165	1,265	1,520
B	1,155	1,295	1,565
C	1,170	1,185	1,430
D	1,080	1,235	1,540
E	210	450	930
F	1,245	1,335	1,515
G	1,325	1,410	1,580
H	1,230	1,340	1,575
I	1,075	1,425	1,550
J	430	630	1,030
K	1,125	1,215	1,450
L	1,280	1,365	1,565
M	1,005	1,150	1,430
N	940	1,065	1,320
Mean of 14	1,030	1,170	1,425

AIRSHIP VOYAGES BY ANALOGY

In his studies of the fascinating problem of the best means to adopt for reaching the North Pole in a dirigible, Mr Wellman hit upon the idea of writing up the log of his aeronef throughout a number of test voyages, assuming that the winds throughout each voyage were the same as those which prevailed at the *Fram*. Accordingly, he named eight dates, somewhat at random, but corresponding generally to the date on which it is expected his trip may be made from Spitzbergen toward the Pole—the latter part of July and early days of August. These dates will be found on the next page. The motor speed of the dirigible is assumed at 12 miles (geographical) per hour. The maximum retardation by the dragging anchor in adverse winds is assumed at 12 miles per hour. Allowance is made for the effect of all winds oblique to the course. For example, in voyage B, from 10 p. m. to midnight, July 25, the wind was SW. at 12 miles per hour, and one-half of its movement, or 12 miles for the two hours, is assumed as the "northing" effect upon the airship.

The start from Spitzbergen is made in the first southerly wind that blows on or after the first of the days named in each of the periods, chosen arbitrarily. Thus the log is written up hour by hour from the *Fram* records, following the method of navigation already described by Mr Wellman in the foregoing pages.

It will be remembered that Dr Nansen's ship, the *Fram*, drifted for three years through the Arctic Ocean, traversing in part the very region the Wellman airship is planned to sail across. As Mr Wellman points out, no one can know that the winds which his airship encounters on its actual voyage are to be like those of any one of these 10-day *Fram* records. But it is only reasonable to assume that they will not be widely different, probably not much better, probably not much worse.

In the most favorable of these examples the vicinity of the Pole is reached in 28 hours.

In the most unfavorable it is reached in 152 hours, of which 68 hours are given to work with the motors and 84 hours to drifting with the retardateur. Inasmuch as it is believed the aeronef can remain in the air from 12 to 20 days, and the fuel supply carried is equal to about 140 hours' motoring, it will be seen that even in this case of the most contrary winds only one-half the radius of the airship is consumed in attaining proximity to the Pole.

It should also be borne in mind that an essential feature of the expedition plan is to carry a complete sledging equipment, with motor-driven sledges, etc., and provisions for 75 days, so that in case the airship should fail through any cause, its crew could resolve themselves into a sledging party and continue their work of exploration or make their way back to the nearest land.

The temperature is not an obstacle to the success of the expedition, as it ranges, during July and the first half of August, about the freezing point, rarely going more than a few degrees above or below zero centigrade. The temperature in the Arctic Ocean in summer is the most constant to be found anywhere on the surface of the globe, and this is a great advantage in aeronautic work, as the gas is subjected to the minimum of dilatation and contraction.

In his studies Mr Wellman has taken account of all other conditions, such as the precipitation of snow, rain, or sleet, which may weigh down the airship, and he has made provisions to meet and overcome this difficulty.

Mr Wellman concludes with the prudent observation that these analyses do not show that he is certain of attaining the Pole by airship, but that they do indicate ground for a reasonable amount of hope and demonstrate that the expedition is planned on a practical and even promising basis.

TEN-DAY AIR-SHIP VOYAGES BY ACTUAL WINDS PREVAILING IN TEN-DAY PERIODS

Argument:

Motor-speed proper of dirigible, 12 miles per hour.
Maximum retardation in adverse winds, 12 miles per hour.
Allowance made for effect of all winds oblique to the course.
Start from Spitzbergen (575 miles from North Pole), with first southerly wind on or after—

A	July 20, 1894	E	Aug. 1, 1895
B	" " 1895	F	" " 1896
C	" " 1896	G	" 10, 1894
D	Aug. 1, 1894	H	" " 1895

Winds throughout assumed to be same as at *Fram* station.

A	Wind.	Miles per hour.	Wind help, 2 hours.	Motor.	Miles north.	Total northing.
July 23.						
N — 2	WbS.	8	4	24	28	28
2 — 4	"	9	5	24	29	57
4 — 6	W.	11	....	24	24	81
6 — 8	WbS.	9	5	24	29	110
8 — 10	W.	8	....	24	24	134
10 — M	SWbW.	7.5	7	24	31	165
July 24.						
M — 2	WbS.	6.5	3	24	27	192
2 — 4	"	8	4	24	28	220
4 — 6	"	6.5	3	24	27	247
6 — 8	WSW.	9	8	24	32	279
8 — 10	WbS.	7	2	24	26	305
10 — N	"	9	5	24	29	334
N — 2	WSW.	13	10	24	34	368
2 — 4	WbS.	10	6	24	30	398
4 — 6	"	11	6	24	30	428
6 — 8	W.	11	....	24	24	452
8 — 10	WbS.	10.5	5	24	29	481
10 — M	"	12	6	24	30	511
July 25.						
M — 2	"	10	6	24	30	541
2 — 4	"	9	5	24	29	570

Total, 40 hours; arrive vicinity the Pole.

B	Wind.	Miles per hour.	Wind help, 2 hours.	Motor.	Miles north.	Total northing.
July 25.						
N — 2	SWbS.	13	16	24	40	40
2 — 4	WbS.	10	4	24	28	68
4 — 6	SW.	11	10	24	34	102
6 — 8	SWbS.	11	12	24	36	138
8 — 10	SW.	10	10	24	34	172
10 — M	"	12	12	24	36	208
July 26.						
M — 2	SWbW.	15	10	24	34	242
2 — 4	SW.	14	14	24	38	280
4 — 6	SWbW.	13	8	24	32	312
6 — 8	SW.	12	12	24	36	348
8 — 10	SWbS.	12.5	15	24	39	387
10 — N	"	15	20	24	44	431
N — 2	SW.	15	15	24	39	470
2 — 4	"	13.5	12	24	36	506
4 — 6	SWbS.	11	13	24	37	543
6 — 8	SSW.	14	15	24	39	582

Total, 32 hours; arrive vicinity the Pole.

C (Observations 4 hours apart.)	Wind.	Miles per hour.	Wind help, 4 hours.	Motor.	Miles north.	Total northing.
July 21.						
N — 4	SE.	4	8	48	56	56
4 — 8	NNE.	3	—10	48	38	94
8 — M	ENE.	3.5	—10	48	38	132
July 22.						
M — 4	NNE.	6.5	—20	48	28	160
4 — 8	NbE.	11	Drift.	1 mph.	— 4	156
8 — N	N	12	"	1 "	— 4	152
N — 4	NNW.	14	"	2 "	— 8	144
4 — 8	"	16	"	4 "	—16	128
8 — M	"	17	"	5 "	—20	108
July 23.						
M — 4	"	18	"	6 "	—24	84
4 — 8	"	17	"	5 "	—20	64
8 — N	N.	15.5	"	3.5 "	—14	50
N — 4	NNW.	12.5	"	1 "	— 4	46
4 — 8	"	14	"	2 "	— 8	38
8 — M	"	12	"	1 "	— 4	34
July 24.						
M — 4	NW.	10.5	"	1 "	— 4	30
4 — 8	NWbW.	9.5	— 30	48	18	48
8 — N	WbN.	5.5	— 6	48	42	90
N — 4	W.	7	....	48	48	138
4 — 8	SWbW.	5.5	8	48	56	194
8 — M	S.	5.5	22	48	70	264
July 25.						
M — 4	SSE.	4	12	48	60	324
4 — 8	"	3.5	10	48	58	382
8 — N	Calm.	....	....	48	48	430
N — 4	SE.	1.5	3	48	51	481
4 — 8	EbN	4.5	— 6	48	42	523
8 — M	ENE.	3	— 5	48	43	566
July 26.						
M — 2	EbN.	5	— 4	24	20	586

Total, 110 hours; arrive vicinity the Pole. 62 hours' motoring. 48 hours' drifting.

D (Observations 2 hours apart.)	Wind.	Miles per hour.	Wind help, 2 hours.	Motor.	Miles north.	Total northing.
Aug. 1.						
N — 2	SbW.	9	15	24	39	39
2 — 4	"	11	18	24	42	81
4 — 6	"	11.5	18	24	42	123
6 — 8	"	14	20	24	44	167
8 — 10	"	12	18	24	42	209
10 — M	"	13	20	24	44	253
Aug. 2.						
M — 2	SSW.	9	14	24	38	291
2 — 4	SWbS.	8	12	24	36	327
4 — 6	SW.	8	8	24	32	359
6 — 8	SSW.	6	8	24	32	391
8 — 10	"	6.5	9	24	33	424
10 — N	SWbS.	5.5	6	24	30	454
N — 2	"	8	11	24	35	489
2 — 4	SW.	6	6	24	30	519
4 — 6	SWbW.	6.5	6	24	30	549
6 — 8	WSW.	7	6	24	30	579

Total, 32 hours; arrive vicinity the Pole.

E.	Wind.	Miles per hour.	Wind help, 2 hours	Motor.	Miles north.	Total northing.
Aug. 1.						
N — 2.	SW	17	16	24	40	40
2 — 4.	SWbW.	13	10	24	34	74
4 — 6.	"	16	14	24	38	112
6 — 8.	WSW.	17	14	24	38	150
8 — 10.	"	15	16	24	40	190
10 — M.	SWbS.	14.5	16	24	40	230
Aug. 2						
M — 2.	SW.	15	14	24	38	268
2 — 4.	"	12	12	24	36	304
4 — 6.	SSW.	12	15	24	39	343
6 — 8.	S.	16	30	24	54	397
8 — 10.	SbW.	15	24	24	48	445
10 — N.	S.	13.5	25	24	49	494
N — 2.	"	14	28	24	52	546
2 — 4.	"	12	24	24	48	594

Total, 28 hours; arrive vicinity the Pole.

F (Observations 4 hours apart.)	Wind.	Miles per hour.	Wind help, 4 hours.	Motor.	Miles north.	Total northing.
Aug. 2						
N — 4.	S.	6.5	26	48	74	74
4 — 8.	SSE.	5	16	48	64	138
8 — M.	SEbE.	4	6	48	54	192
Aug. 3.						
M — 4.	EbN.	9.5	—16	48	32	224
4 — 8.	"	12	—20	48	28	252
8 — N.	"	12	—20	48	28	280
N — 4.	ENE.	16	Drift.	4 mph.	—16	264
4 — 8.	NEbE.	17.5	"	5 "	—20	244
8 — M.	NE.	15	"	3 "	—12	232
Aug. 4.						
M — 4.	NEbN.	16	"	4 "	—16	216
4 — 8.	N.	13.5	"	1.5 "	— 6	210
8 — N.	"	17	"	5 "	—20	190
N — 4.	"	16	"	4 "	—16	174
4 — 8.	"	15	"	3 "	—12	162
8 — M.	NWbN.	14	"	2 "	— 8	154
Aug. 5.						
24 hours	NW.	16	"	3 "	—72	82
Aug. 6.						
24 hours	NW.	12.5	"	1 "	—24	58
Aug. 7.						
M — 4.	NWbW.	6	—10	48	38	96
4 — 8.	"	6	—10	48	38	134
8 — N.	W.	10	....	48	48	182
N — 4.	WNW.	6.5	—12	48	36	218
4 — 8.	W.	5.5	....	48	48	266
8 — M.	WSW.	6	12	48	60	326
Aug. 8.						
M — 4.	WSW.	9	14	48	62	388
4 — 8.	W.	8	....	48	48	436
8 — N.	"	8	....	48	48	484
N — 4.	WSW.	4.5	8	48	56	540
4 — 8.	SW.	6	12	48	60	600

Total, 152 hours; arrive vicinity the Pole. 68 hours' motoring. 84 hours' drifting.

G (Observations 2 hours apart.)	Wind.	Miles per hour.	Wind help, 2 hours.	Motor.	Miles north.	Total northing.
Aug. 11.						
M — 2	SW.	6	6	24	30	30
2 — 4	SWbS.	5	6	24	30	60
4 — 6	SW.	7	7	24	31	91
6 — 8	SWbS.	7	8	24	32	123
8 — 10	SSW.	8	10	24	34	157
10 — N	SW.	10	10	24	34	191
N — 2	"	10	10	24	34	225
2 — 4	"	7.5	7	24	31	256
4 — 6	"	10	10	24	34	290
6 — 8	"	7	7	24	31	321
8 — 10	"	6.5	6	24	30	351
10 — M	SWbS.	8	10	24	34	385
Aug. 12.						
M — 2	SWbS.	5	6	24	30	415
2 — 4	"	5	6	24	30	445
4 — 6	"	5	6	24	30	475
6 — 8	WSW.	4.5	3	24	27	502
8 — 10	"	5	4	24	28	530
10 — N	"	4.5	3	24	27	557
N — 2	SWbW.	5.5	4	24	28	585

Total, 38 hours; arrive vicinity the Pole.

H (Observations 2 hours apart.)	Wind.	Miles per hour.	Wind help, 2 hours.	Motor.	Miles north.	Total northing.
Aug. 18.						
N — 2	WbS.	12.5	6	24	30	30
2 — 4	SW.	13.5	13	24	37	67
4 — 6	SWbW.	12.5	10	24	34	101
6 — 8	SW.	15	15	24	39	140
8 — 10	SWbS.	15	16	24	40	180
10 — M	SW.	14	14	24	38	218
Aug. 19.						
M — 2	SW.	12	12	24	36	254
2 — 4	"	13	13	24	37	291
4 — 6	SWbW.	9.5	8	24	32	323
6 — 8	WbS.	7.5	4	24	28	351
8 — 10	NW.	6.5	—7	24	17	368
10 — N	WbS.	7	3	24	27	395
N — 2	WbN.	12	—8	24	16	411
2 — 4	WbS.	11	6	24	30	441
4 — 6	"	10	5	24	29	470
6 — 8	"	9	4	24	28	498
8 — 10	"	7	2	24	26	524
10 — M	SSW.	6	7	24	31	555
Aug. 20.						
M — 2	SW.	10	10	24	34	589

Total, 38 hours; arrive vicinity the Pole.

FARMING ON THE ISTHMUS OF PANAMA

BY DILLWYN M. HAZLETT

FROM personal experience and observation extending from Colon to Panama, I can sincerely indorse what the Isthmian Canal Commission said in its last report: "In view of the gratifying conditions shown by recent statistics, it may be safely said that the problem of sanitation need no longer be considered a formidable obstacle to the construction of the canal." Any person in the States can go to the Isthmus and do the same kind of work, and as much of it, as at home and enjoy just as good health as at home, when attention is paid to the ordinary laws of health.

I bought a Panama hat, a pair of leggins, and a khaki suit. For four weeks I rode on the railroad, sailed along the coast, rowed up and down the Chagres River, and tramped through the tropical undergrowth, frequently myself cutting the way with the machete. And I did not go empty handed. I had either my 8 x 10 or 11 x 14 camera and a dozen plates, and sometimes both. I found this no different from doing similar work in the summer time anywhere. The thermometer, by my own record, never went higher than 86 degrees in the shade at midday, and was as often only 82 and 84 degrees in the shade. There was always a nice breeze and fewer pestiferous insects than I had found in many places in the States.

The most perplexing question that con-

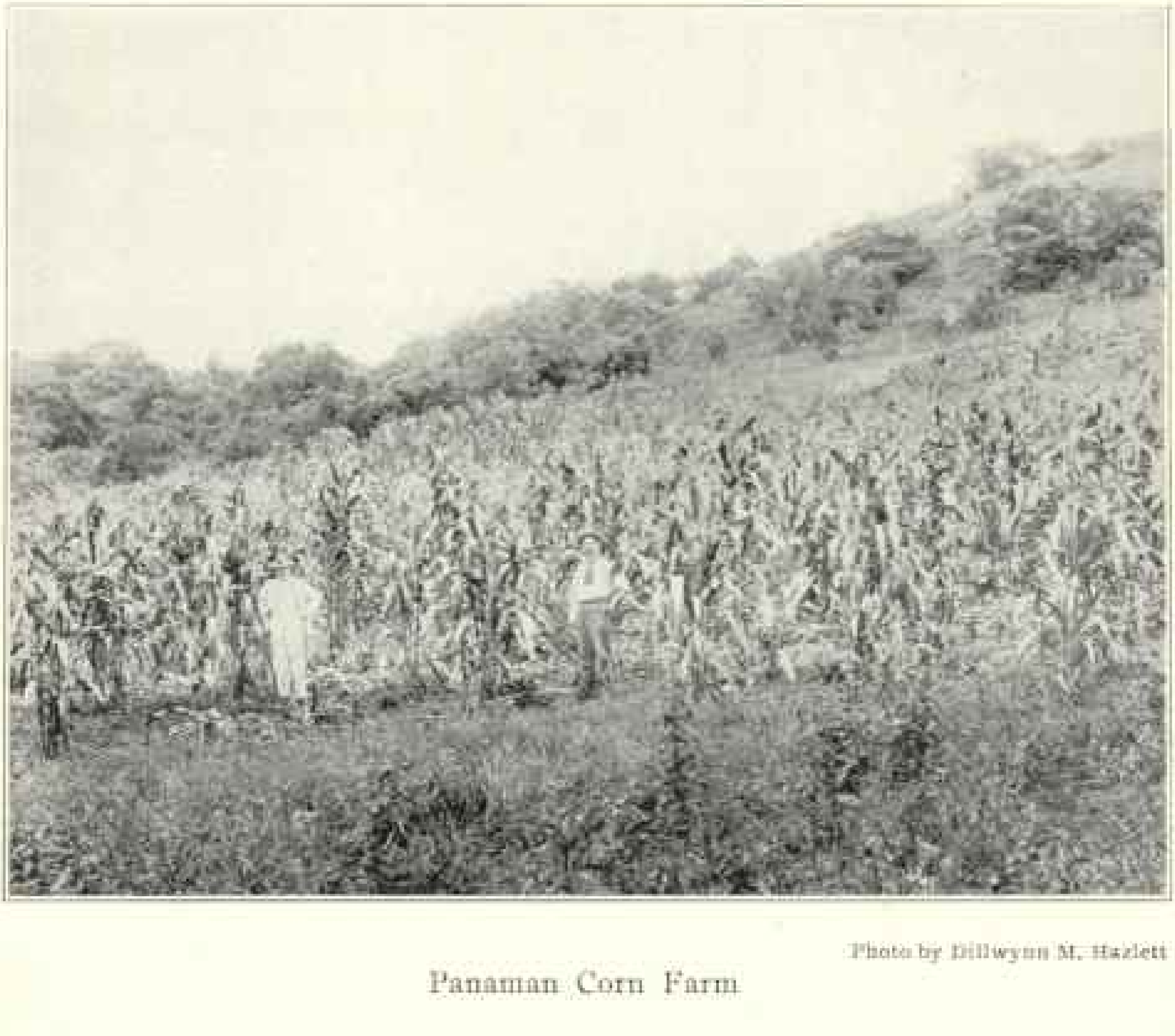


Photo by Dillwynn M. Hazlett

Panaman Corn Farm

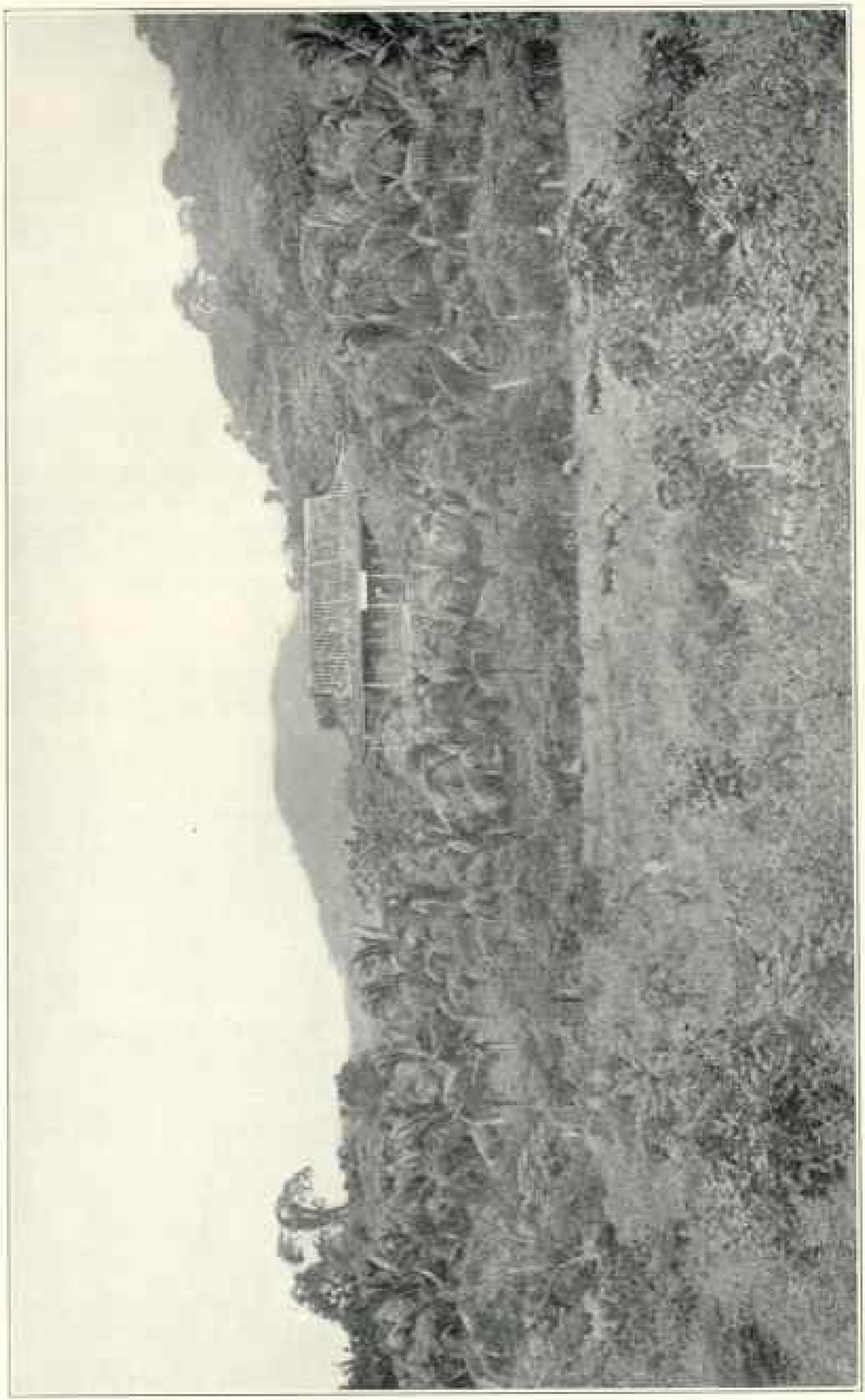


Photo by Dillwyn M. Hazlett

Farm of Albredo Aleman, Panama

Photo by Dillwynn M. Hazlett

Panaman Mango

fronts the Isthmian Canal Commission and will confront the contractor, if the work is sublet, is that of "unskilled labor." The report of the Commission is: "The question of labor is a grave and perplexing one. A sufficient supply of labor can be secured from near-by tropical islands and countries, so far as numbers are concerned. The question of quality is a very different matter. Unless a much greater efficiency can be developed than is secured at present, it will be necessary to look elsewhere for a better class. As compared with the best common labor in the United States, its efficiency is rated at from 25 to 33 per cent." I do not believe that either the government or the contractor will be satisfied with this inefficiency. If they are the canal will not be finished in less than 20 years, or at less than four times its estimated cost. All alien labor is inefficient in comparison with the good common labor in the United States. The best way to get rid of the inefficiency of alien labor would be to employ the brawn of the farm and factory that is in the States. With good sanitation, housing and feeding, and a fair wage, this kind of unskilled labor could be had. To thousands of our citizens labor has not yet become dishonorable, nor has the spirit of patriotism departed. We as Americans have said, "The canal shall be built." "We shall succeed where others fail." "We have not only the money and

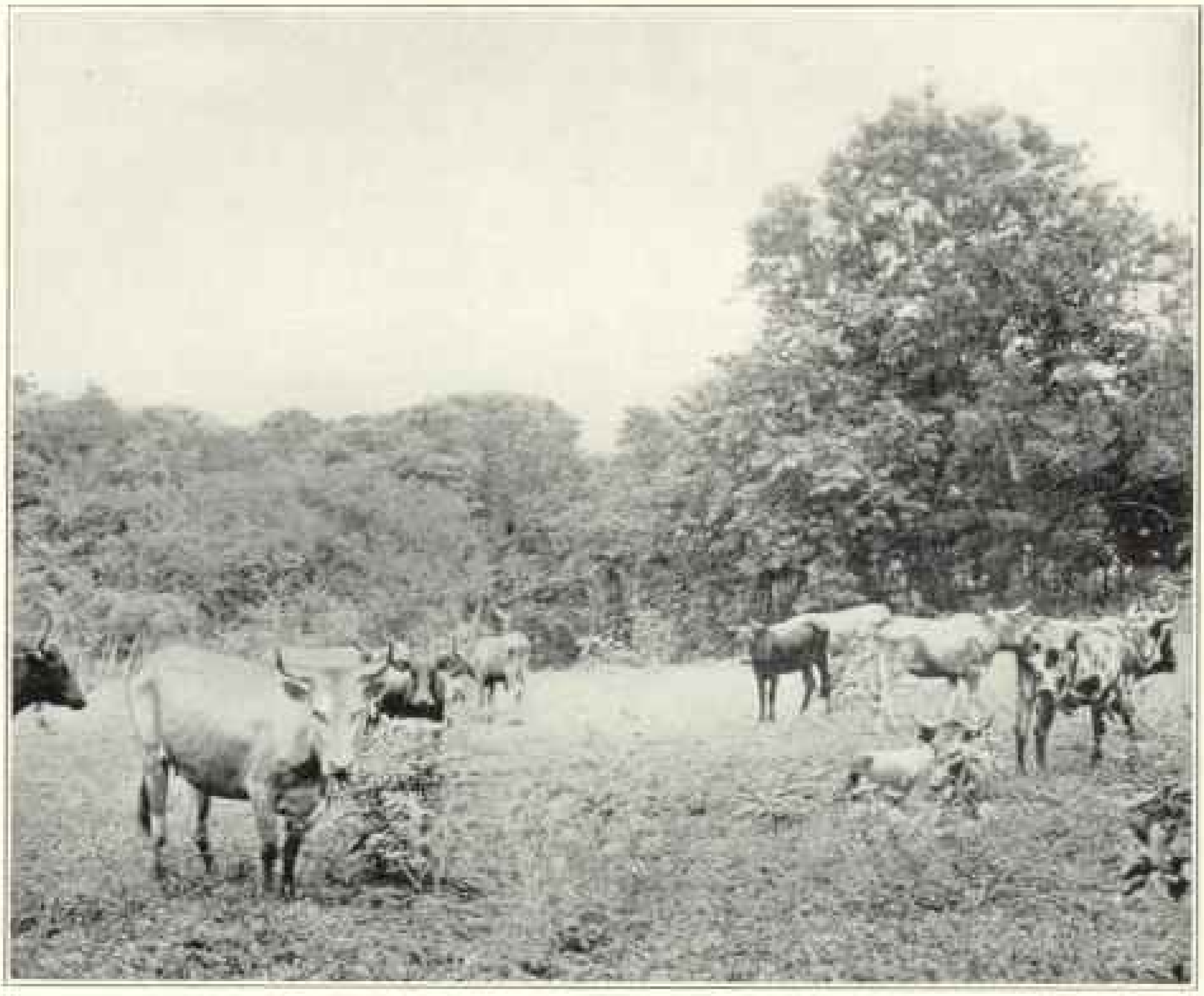


Photo by Dillwynn M. Hazlett

Panaman Cattle

the brains, but also the muscle necessary successfully to complete this great and good work, beneficial not only to ourselves, but to the whole world."

A recent writer, concerning the feeding of the men employed on the canal, says: "Panama is 2,000 miles distant from a base of supplies, and the greater part of the work will necessarily be done in a jungle and under severe climatic conditions." This is the usual idea of those who have not visited the Isthmus and familiarized themselves with the facts. If the "climatic conditions are severe" now, will they not be so when the canal is finished? Will not its maintenance require that work to be done "under severe climatic conditions"? I found these "severe climatic conditions" today to be such that scores of men now employed on the Isthmus have determined to make it their future home. The small population of the Isthmus is not due to the "severe climatic conditions" as much as to the ignorance of the true climatic conditions, the marvelous fertility of the soil, and the natural resources of the country. As these become better known, we will witness a rapid increase of its population.

Nor will "the greater part of the work necessarily be done in a jungle." The canal route follows in the main close by the Panama Railroad from Colon to Panama. It passes through cultivated fields as well as through virgin tropical forests. The distance from Colon to Panama is 47.65 miles, with the following 28 stations intervening: "Cristobal, Mount Hope, Mindi, Gatun, Lion Hill, Ahorca Lagarto, Bohio, Frijoles, Tabernilla, Barbacocas, Empire, Culebra, Rio Grande Superior, Cucaracha, San Pablo, Bailamonos, Mamei, Gorgona, Matachin, Bas Obispo, Las Cascadas, Paraiso, Pedro Miguel Junction, Pedro Miguel Tank, Mira Flores, Corozal, La Boca Junction." Some of these stations, like those along railroads in the States, consist of a house or two, while others are respectable little villages.

Then the base of supplies need not be "2,000 miles distant from Panama." If we move "the base of supplies" from New York city to Mobile, New Orleans, or Galveston, we bring it 600 miles, or from one and a half to two days by steamer, nearer Panama. But as we are moving, let us keep on and move it all the way to Panama. Why?

The soil of the Isthmus is the best in the world and, in conjunction with climatic conditions, produces fine fruits, vegetables, and cereals, with perpetual pasturage for cattle and fowl. Every kind of vegetable grown in the United States except celery and asparagus does well. They can be planted in succession, so that there will be a perpetual supply, the quantity that can be raised depending only on the amount planted and cultivated. Of fruits, the pineapple and banana mature in one year from the time of planting; oranges and cocoanuts, in eight years, although both begin bearing before that time. Figs, I think, can be successfully introduced and will yield well.

Rice and corn yield fair crops, and doubtless the quality and quantity per acre could be increased by cultivation and selection of seed. It is usual to raise three crops of corn on the same ground during one year, and although the soil is absolutely uncultivated, excellent corn is harvested. The method of raising corn is to cut down the forest that covers the ground; then, as soon as it is dry enough to burn, to set fire to it. This fire heats the surface of the soil and kills the seed of weeds therein. The next morning the corn is planted. The soil is so loose that the first man just makes a little hole with the point of his machete. The next man drops in the grains of corn, and the man behind covers the grains with his toe. They don't know anything about "the man with the hoe." The corn of course gets the start of the weeds, deeper down, so that later the weeds are handicapped in their growth by the shade of the corn. As can be seen from the picture, the results, without any cultivation whatsoever, equal those obtained only by good cultivation in many places in the States.

The picture of the orange tree shows that these trees will grow and bear fruit even under adverse conditions. The history of this particular tree is that six years ago, in eating an orange in his garden, Mr Alfredo Aleman threw the seeds over the fence. Shortly afterwards he noticed that one of these seeds had lodged in the crevice of a rock and was growing. So he determined to let it alone. It continued to grow, and, as can be seen, the roots have covered the rock, finding their way into the fertile soil, so that it is laden with fruit.

The land between Colon and Panama is not sandy, stony, or mountainous. Only shallow blue valleys sentineled by low, verdant hills. Everywhere the soil is fertile as a garden, producing abundantly when merely tickled. American truck gardeners could produce an abundance of all the fruits and vegetables that would be needed, no difference how great the number of the employed might be. Where the virgin forest has been cut away and the soil tilled, there is no malaria, fevers, or mosquitoes. These results follow in the tropics just as they do like work in Kansas, Missouri, or anywhere else. Cattle and fowls do well. There is an abundance of fish of the very best kinds in the waters on both sides of the Isthmus. In fact, "Panama," is an Indian word meaning "Abundance of Fish."

While it is true that "the natives never look beyond their present necessities" (and they do not need to do so), and hence "no surplus food supply ever accumulates," this condition need not continue. I am informed by the Isthmian import from the States the food needed by the employees, this practice will not be continued through all the years of the work and after the work is completed.

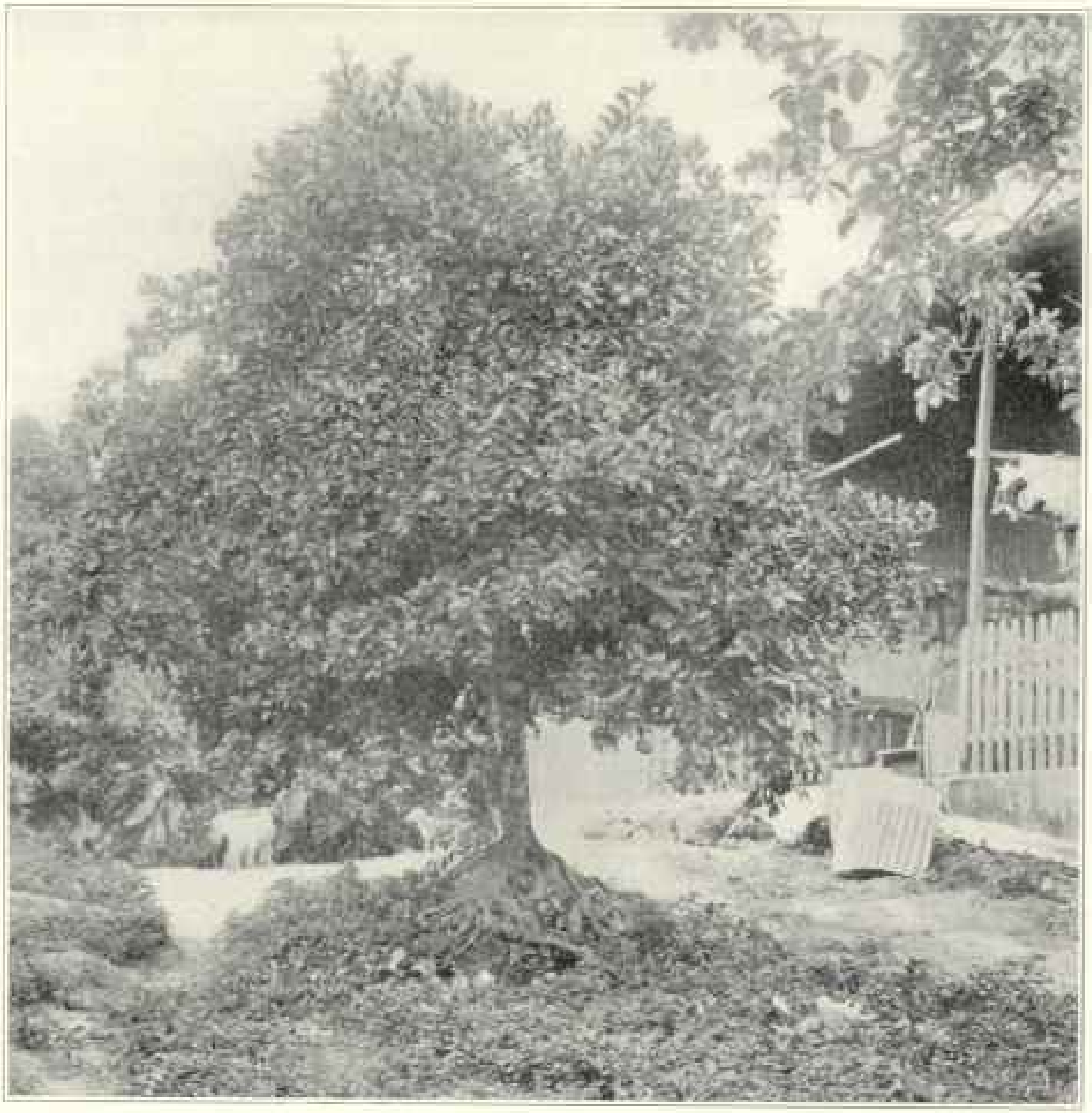
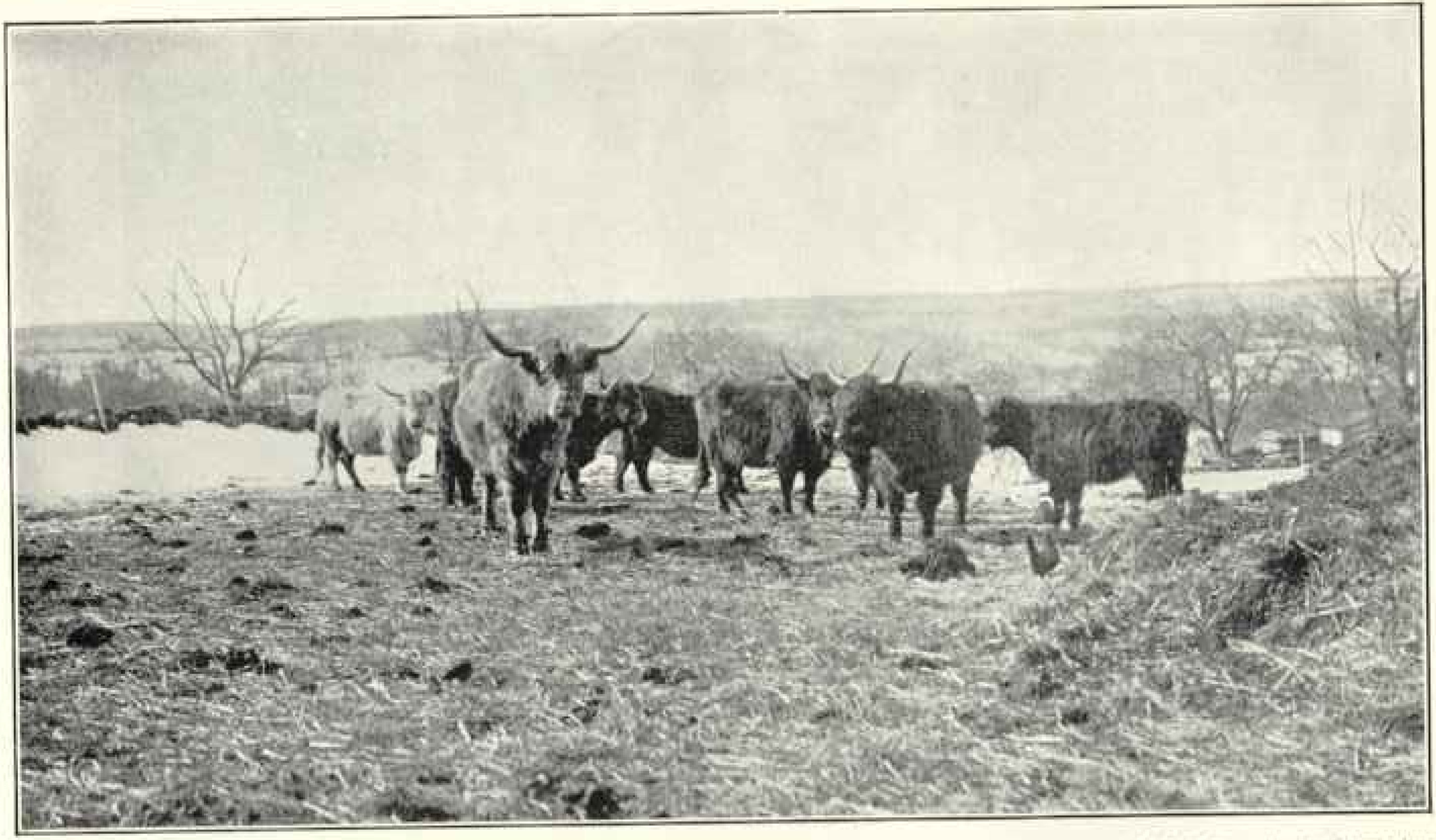


Photo by Dillwynn M. Hazlett

Orange Tree, Six Years Old, Panama (see preceding page)

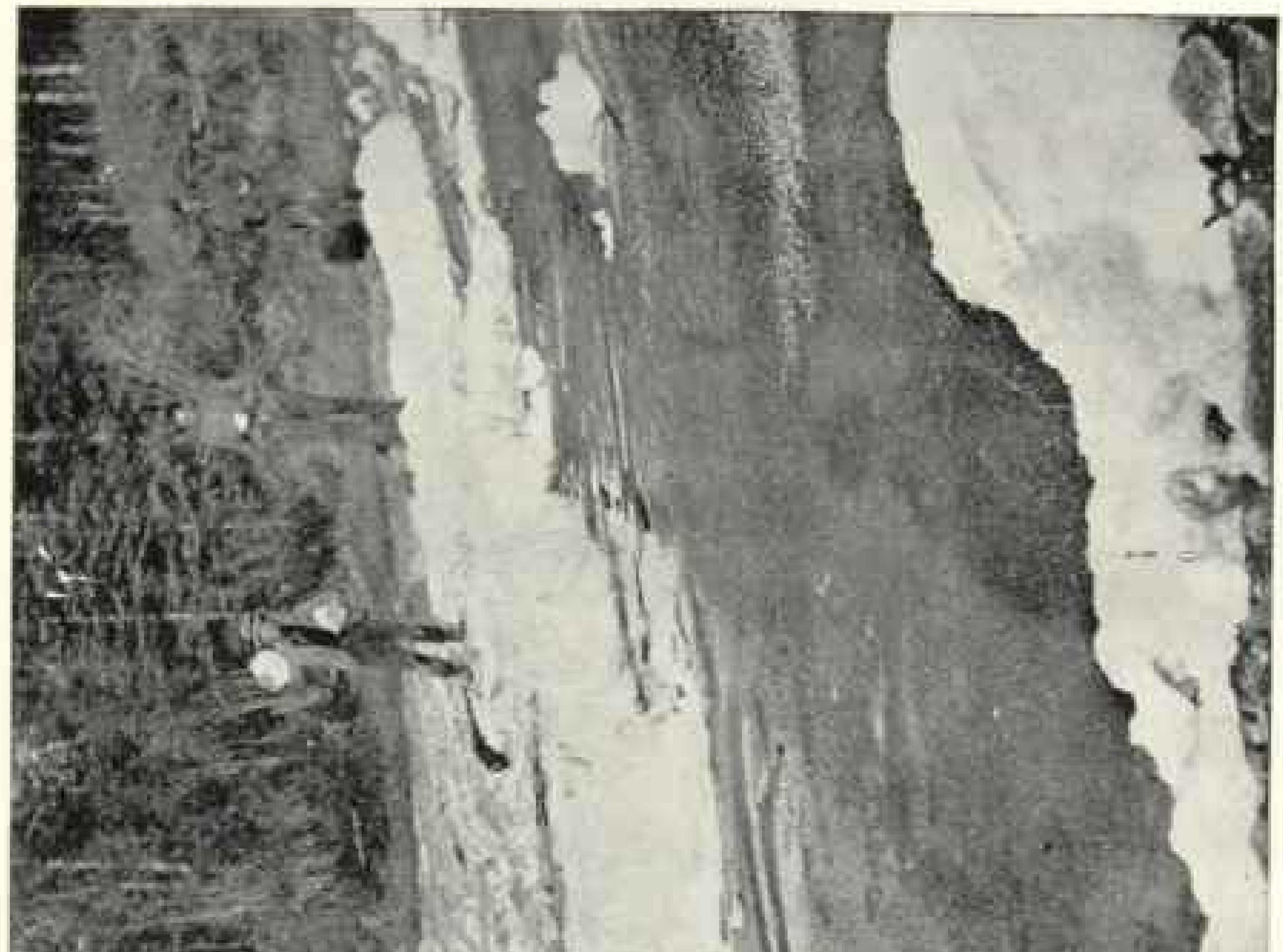
Canal Commission that under certain conditions land can be leased for five years in the Canal Zone. While of course it will be necessary for a year or more to This difficulty that stands in the way at present, like others, may disappear speedily through American ability, intelligence, and energy.



From the U. S. Department of Agriculture

A Group of Highland Cattle on the Farm of Mr W. M. Van Norden, Rye, N. Y.

The Department of Agriculture believes that this type of cattle can be successfully introduced into colder regions of the United States and into Alaska. At present there are only two or three herds in this country



From "Canadian Life and Resources"

The Wonderful Salt Deposit in the little known Athabasca District of Northern Alberta

AN INTERESTING PHOTOGRAPH

THE first impression from the picture on the opposite page is that it is a winter scene, with a river flowing past snow-covered banks; but what looks like snow is in reality the purest salt. It furnishes excellent table salt without further preparation. Some six feet underneath it a coarser quality, similar to the "Liverpool salt," is found. Springs of water running through this salt bed are surcharged with salt and deposit their residue in the form shown in the picture. The trees in the background are underlaid with pure white salt, and on the removal of the top soil to a depth of some three or four feet a solid hill of salt is reached.

Walter Wellman

MAGNETIC SURVEY OF THE PACIFIC OCEAN

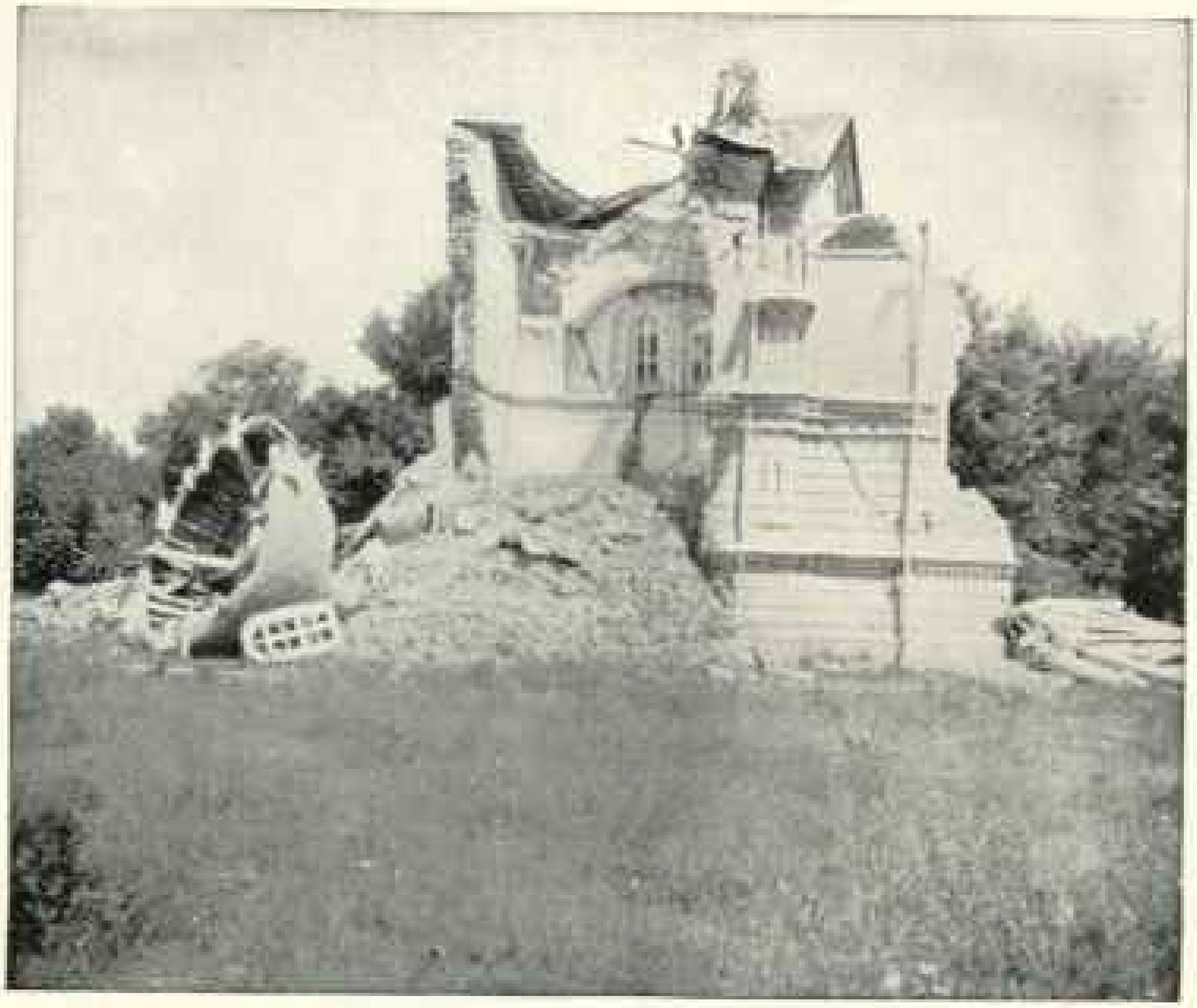
THE Yacht *Galilee*, engaged in the magnetic survey of the Pacific Ocean, under the auspices of the Carnegie Institution of Washington, left San Diego, California, on March 2 to enter upon her second cruise. She is expected to make the following circuit of about 20,000 miles by the end of this year: San Diego, Fanning Island, Samoan Islands, Fiji Islands, Marshall Islands, Guam, Yokohama, Aleutian Islands, and back again to San Diego.

It was necessary to reorganize the scientific personnel, as those of the former staff belonging to the U. S. Coast and Geodetic Survey were obliged to return to their official duties at the expiration of their furloughs. The command of the vessel has accordingly now been entrusted to Mr W. J. Peters, formerly of the astronomical and topographical corps of the U. S. Geological Survey. He has had considerable experience in difficult geographical work, was second in command and in charge of the scientific work of the recent Ziegler Polar Expedition as the representative of the National Geographic Society.

In connection with the latter expedition, Mr Peters made a valuable series of magnetic, meteorological and tidal observations at Teplitz Bay, Franz Josef Land. The other members of the present staff are: Mr J. P. Ault, magnetic observer (likewise a member of the former staff); Mr J. C. Pearson, magnetic observer (formerly instructor of physics at Bowdoin College), and Dr H. E. Martyn, surgeon and recorder. While the vessel was at San Diego some additional changes and improvements were made both in the ship and in the instruments employed. Sufficient funds have been allotted so as to permit carrying on this work continuously throughout the year.

According to a dispatch received at the office of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, the Yacht *Galilee*, engaged in the magnetic survey of the Pacific Ocean, arrived safely at Fanning Island on March 31, having accomplished the trip of 3,500 miles from San Diego in 29 days, besides executing successfully magnetic work along the entire cruise.

L. A. BAUER.



Russian Chapel after the Earthquake, Andijan

From O. T. Crosby, "Tibet and Turkestan"

A Kashgar Crowd

From O. T. Crosby, "Tibet and Turkestan"

A Samarcand Jewess in Ceremonial Attire

Tibet and Turkestan. By Oscar Terry Crosby. With illustrations, map, and index. Pp. 321. 5¼ x 8 inches. New York and London: G. P. Putnam's Sons. 1905.

The story of Tibet and Turkestan, past and present; something of the daily life and surroundings of the people, their religions, customs, and institutions, and the political situation of the country have been included in the twenty-one chapters of the book. The author's experiences in traveling through the freezing climate of the Tibetan plateau are extremely interesting, giving the uninitiated a general idea of the hardships undergone by travelers seeking to unravel the mysteries of Tibet.

Irrigation and the "Yellow Peril" are discussed, but the author does not seem to think that we should fear much from the latter, though he believes that China has shown her capability of future strength. She has built and is maintaining a telegraph line from Pekin to Kashgar, a distance of more than 2,000 miles, so quietly that its establishment has been almost unnoticed by many well-informed people outside of China.

The wisdom of the Tibetan war is doubted by Mr Crosby, and he claims that his views are in accord with those of many Englishmen whose opinions carry weight.

The preface contains a bibliography and there are several appendices, one being a collection of Tibetan songs which show "the characteristics of a people who are as yet very unfamiliar to us."

THE ROOSEVELT GLACIER

NEW YORK, *February 19, 1906.*

Editor National Geographic Magazine.

DEAR SIR: I wish to report to you the existence of five glaciers in the Wind River Mountains of Wyoming. These glaciers were visited by Mr Howard Fuguet, of Philadelphia, and myself, with our guides, in September, 1904, and September, 1905. After careful inquiry we are convinced that we are the first persons to visit these glaciers. I have talked with many persons resident in that portion of Wyoming, and last summer wrote the Geological Survey in regard to them, but have failed to find that they have ever been visited save by our party.

They are situated on the head of Green River, near Fremont's and the neighboring peaks. The three main ones lie in crescent shape on the north and east sides of Fremont's and the adjacent peaks, and are of considerable size, measuring roughly three miles around the curve of the crescent, one mile in width, and two hundred feet in thickness. Except in seasons of light snowfall, the rock ridges which separate these glaciers are covered with snow, giving the appearance of one large glacier.

The President has very kindly given his permission to call these the Roosevelt Glaciers, and we have so named them. The other two glaciers lie, one three miles to the west and the other four or five miles to the north of the main ones, and are very much smaller.

Yours truly,

C. M. TAINTOR.

NATIONAL GEOGRAPHIC SOCIETY

Wednesday, April 4—Hubbard Memorial Hall, 8 p. m. "The Fundamental Principles of Buddhism." By Rt. Rev. Shaku Soyen Lord Abbot, of Yengakuji Temple, Kamakura, Japan. Dr D. T. Suzuki, of Tokio, will act as interpreter.

Friday, April 6—Hubbard Memorial Hall, 8 p. m. "Photographing Wild Game with the Flashlight." By Hon. George Shiras, 3d. Some remarkable photographs by Mr Shiras will be shown on lantern slides.

Saturday, April 7—National Rifles' Armory, 920 G St., 8 p. m. "The Cannibal Regions of the West Central Sudan." By Dr H. Karl W. Kumm, F. R. G. S. Illustrated. The lecturer has been for several years a medical missionary in the Sudan. He will incidentally describe the "sleeping sickness."

Tuesday, April 10—Hubbard Memorial Hall, 8 p. m. "The Reduction of the Samaon Root, an Evolutionary Study in Archetypal Philology." By William Churchill.

Monday, April 16—Hubbard Memorial Hall, 8 p. m. "The Home of the Indo-European." By G. M. Bolling, Ph.D., Professor of Greek Literature and Comparative Philology and Sanskrit in the Catholic University of America.

Friday, April 20—Hubbard Memorial Hall, 8 p. m. "The Protection of the United States Against Invasion by Disease." By Dr Walter Wyman, Surgeon-General Marine Hospital Service.

It is hoped that official business will permit the Secretary of the Navy, Hon. Charles J. Bonaparte, to address the Society during May. The address by Mr George Kennan, previously announced for April, has been postponed until November, as Mr Kennan does not return from the Far East until the latter part of May.

The following committees for the year 1906 have been appointed by President Willis L. Moore:

Executive Committee—President, Vice-President, Treasurer, Secretary, Messrs Henry F. Blount, Gilbert H. Grosvenor, and Alfred J. Henry.

Admissions—O. P. Austin and Gilbert H. Grosvenor.

Communications (Lectures and Meetings)—Gilbert H. Grosvenor.

Excursions—Henry F. Blount, F. V. Coville, Gilbert H. Grosvenor, and Otto Luebkert.

Finance—Charles J. Bell, John Joy Edson, and Gilbert H. Grosvenor.

Library—O. P. Austin, Gilbert H. Grosvenor, and H. H. Kimball.

Publications—Gilbert H. Grosvenor, A. W. Greely, W J McGee, C. Hart Merriam, Willis L. Moore, O. H. Tittmann, O. P. Austin, Alexander Graham Bell, David T. Day, Alfred H. Brooks, Angelo Heilprin, R. D. Salisbury, G. K. Gilbert, Alexander McAdie, Almon Gunnison, and David G. Fairchild.

Research—Henry Gannett, chairman; C. Hart Merriam, F. V. Coville, A. J. Henry, O. H. Tittmann, C. W. Hayes, L. A. Bauer, W. H. Holmes, O. P. Austin, and C. M. Chester (with power of the chairman to add to its members).

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