SCIENCE

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MULTIPLICITY OF CROPS AS A MEANS OF INCREASING THE FUTURE FOOD SUPPLY[1]

ECONOMISTS prophesy a deficiency in the world's food supply. The cost of living everywhere portends accuracy in their divination. The fast and furious struggle between nations and individuals for land upon which to grow food augurs lean years to come. Census enumerations of population presage sooner or later a dearth of ammunition among the multiplying peoples of the earth to carry on the battle of life. Of all this you need to be reminded rather than informed.

So many men have stated and attempted to solve the problem of the future food supply that it would seem that the subject has been wholly talked out from the facts at hand. Indeed, there has been so much said and written about hard times at hand and famine ahead that I doubt if you are pleased to have your premonitions reawakened by further forebodings and to be forced, through the prestige of the president's chair, to give attention to a subject which has been so much discussed. Thrashing over old straw in the presidential chair is, I quite agree with you, a most abominable practise and I have done my best to bring a few sheaves of grain to the thrashing I am now beginning.

Agricultural economists discuss three rather general means of securing a food supply for those who live later when the earth teems with human beings. These are: conservation of resources; greater acreages under cultivation; and increased

[1] Presidential address, Society for Horticultural Science, Washington, D. C., 1913.

yields from improved plants and through better tillage. It is difficult to anticipate the problems that will confront us when people swarm on the land, as now in India or China, but I venture the prediction that if in that day "the evil arrows of famine" are sent upon us, a fourth means of supplying food will be found quite as important as the three named.

We shall find, long before famine overtakes us, that the natural capacity of soils and climates to produce a diversity of crops is one of the greatest resources for an increased food supply. As yet, multiplicity of crops as a means of augmenting the supply of food has received little attention and I want to bring you to a better realization of its possibilities in the half hour at my disposal, attempting to show, in particular, how greatly the necessities and luxuries of life can be increased by the domestication of wild esculents; by better distribution of little-known food plants; and by the amelioration of crops we now grow through breeding them with wild or little-known relatives.

Few, even among those who have given special attention to agricultural crops, have a proper conception of the number that might be grown. De Candolle, one of the few men of science who have made a systematic study of domesticated plants, and whose "Origin of Cultivated Plants" has long been sanctioned by science as authoritative, is much to blame for the current misconception as to the number of plants under cultivation. By conveying the idea that his book covers the whole field, De Candolle prepared the ground for a fine crop of misunderstandings.

Humboldt had stated in 1807 that

> The origin, the first home of the plants most useful to man, and which have accompanied him from the remotest epochs, is a secret as impenetrable as the dwelling of all our domesticated animals.

De Candolle set out to disprove Humboldt. He assorted cultivated plants in 247 species and ascertained very accurately the histories of 244 out of the total number. De Candolle's thoroughness, patience, judgment, affluence of knowledge, clear logic and felicity of expression, make his book so trustworthy and valuable in most particulars, that we have accepted it as the final word in all particulars, overlooking his faulty enumeration and forgetting that most of his material was gathered more than a half century ago.

My first task is to establish the fact that the number of plants now cultivated for food the world over is not appreciated in either science or practise. Neither are botanists nor agriculturists seemingly well aware of the number of edible plants not domesticated which are in times of stress used in various parts of the world for food, many of which can well be grown for food. Your attention must be called to the number of these.

Inspiration for this discussion of the undeveloped food resources of the plant-kingdom came to the speaker from the use of notes left at the New York Agricultural Experiment Station by the first director of the station, the late Dr. E. Lewis Sturtevant, who gave most of his life to the study of economic botany. His pen contributions on cultivated plants in agricultural and botanical magazines cover thirty years and number many titles. In addition, the unpublished material just mentioned, under the heading "Edible Plants of the World" takes up over 1,600 typewritten pages. During his life, Dr. Sturtevant was in the full tide of American science, but I am sure could he have lived to publish the great treatise which he had planned on edible plants, and upon which he worked for twenty years, we should give him much higher rank with giants of science,

and that his book would now be the *magnum opus* of economic botany.

De Candolle, as we have seen, includes but 247 cultivated species in his work. This is approximately the number generally thought to minister to the alimentary wants of man. Sturtevant, in his notes on edible plants, enumerates 1,113 domesticated species now cultivated, and a total of 4,447 species, some part or parts of which are edible. Following De Candolle, Sturtevant made use of botany, archeology, paleontology, history and philology in obtaining his data. He searched the literature of the world from the earliest records in Egyptian, Chinese and Phœnician until the time of his death to make a complete record of the edible plants of the world. Sturtevant's were the species, too, of a generation ago, many of which have since been divided twice, thrice or oftener by later botanists. It is said that no food plant of established field culture has ever gone out of cultivation, an approximate truth, at least, from which we may presume that the number of cultivated plants is not smaller than the numbers given from our author's notes.

In leaving this phase of my subject, I can not but say that, despite the fulness of Sturtevant's notes, the feeling comes in reading them, as it does in reading De Candolle, Darwin or whoever has written on the domestication of plants, that what has so far been found out is so little in comparison to what we ought to know regarding the modification of cultivated plants by man, that our present knowledge but makes more apparent the dire poverty of our information.

Passing now to a more direct discussion of the subject in hand, I have to say that I have chosen to discuss three general means of developing the latent possibilities in the plant-kingdom for agriculture. It may help to hold your attention if I discuss these in order of their importance—the most important last. They are: First, the domestication of the native plants of any region. Second, better distribution of plants now cultivated. Third, the utilization of hybridization to bring into being new types of plants better suited to cultivation and to the uses of man.

In the matter of domesticating plants let us glance hastily at what has and what can be done in our own country. In De Candolle's treatise we make but a poor showing, indeed. Out of his 247 cultivated species but 45 are accredited to the New World and but three of these—the pumpkin, Jerusalem artichoke and persimmon—come from North America. To these three Sturtevant adds about thirty. The poor showing made by our continent in furnishing food plants, it must be made plain, is not due to original inferiority. The number would be vastly greater, as Asa Gray long ago pointed out, had civilization begun in this rather than in the Old World. It is probable, indeed, that the numbers would be approximately equal if civilization had begun as early in the Western as in the Eastern Hemisphere.

What are some of these plants that Gray and other botanists have so often told us might have been and may yet profitably be domesticated? The list is far too long to catalogue, but you will permit me time for a few examples, choosing those that are still worth domesticating for some special purpose or environment. Fruits give us most examples.

Wild fruits abound in North America. The continent is a natural orchard. More than 200 species of tree, bush, vine and small fruits were commonly used by the aborigines for food, not counting nuts, those occasionally used, and numerous rarities. In its plums, grapes, raspberries,

blackberries, dewberries, cranberries and gooseberries North America has already given the world a great variety of new fruits. There are now under cultivation 11 American species of plums, of which there are 433 pure-bred and 155 hybrid varieties; 15 species of American grapes with 404 pure and 790 hybrid varieties; 4 species of raspberries with 280 varieties; 6 species of blackberries with 86 varieties; 5 species of dewberries with 23 varieties; 2 species of cranberries with 60 varieties and 2 gooseberries with 35 varieties. Here are 45 species of American fruits with 2,226 varieties, domesticated within approximately a half century. De Candolle named none of them. The final note of exultation at this really magnificent achievement of American horticulture would typically be uttered in a boast as to the number of millions of dollars these fruits bring fruit-growers each year, but science is not sordid and the calculation, I am sure, would not interest you.

What more can be done? The possibilities of the fruits named have by no means been exhausted. The fruit of the wild plum, *Prunus maritima,* an inhabitant of sea-beaches and dunes from New Brunswick to the Carolinas, is a common article of trade in the region in which it grows, but notwithstanding the fact that it readily breaks into innumerable forms and is a most promising subject under hybridization, practically nothing has yet been done toward domesticating it. Few plants grow under such varied conditions as our wild grapes. Not all have been brought under subjugation, though nearly all have horticultural possibilities. It is certain that some grape can be grown in every agricultural region of the United States. The blueberry and huckleberry, finest of fruits, and now the most valuable American wild fruits, the crops bringing several millions of dollars annually, are not yet domesticated. Coville has demonstrated that the blueberry can be cultivated. Some time we should have numerous varieties of the several blueberries and huckleberries to enrich pine plains, mountain tracts, swamps and waste lands that otherwise are all but worthless. A score or more native species of gooseberries and currants can be domesticated and should some time extend the culture of these fruits from the Gulf of Mexico to the Arctic Circle. There are many forms of juneberries widely distributed in the United States and Canada, from which several varieties are now cultivated. The elderberry is represented by a dozen or more cultivated varieties, one of which, brought to my attention the past season, produced a half hundred enormous clusters, a single cluster being made up of 2,208 berries, each a third of an inch in diameter.

These are but a few of the fruits—others which can only be named are: the anonas and their kin from Florida; the native crab-apples and thorn-apples; the wineberry, the buffalo-berry and several wild cherries; the cloud-berry prized in Labrador; the crow-berry of cold and Arctic America; the high-bush cranberry; native mulberries; opuntias and other cacti for the deserts; the paw-paw, the persimmon, and the well-known and much-used salal and salmon berries of the west and north.

The pecan, the chestnut and the hickory-nut are the only native nuts domesticated, but some time forest and waste places can be planted not only to the nuts named, but to improved varieties of acorns, beech-nuts, butternuts, filberts, hazels, chinquapins and nut-pines, to utilize waste lands, to diversify diet and to furnish articles of food that can be shipped long distances and be kept from year to year. The fad of to-day which substitutes nuts for meat may become a necessity to-morrow. Meanwhile

it is interesting to note that the pecan has become within a few decades so important a crop that optimistic growers predict in another half century that pecan groves will be second only to the cotton fields in the south. A recent bulletin from the United States Department of Agriculture describes 67 varieties, of which more than a million and a half trees have been planted.

It is doubtful whether we are to change general agriculture much by the domestication at this late date of new native grains, though many may well be introduced from other regions and wonderful improvement through plant-breeding is, as all know, now taking place. Raw material exists in America for domestication, but it is not probable that we shall ever use it extensively.

There are, however, a number of native vegetables worth cultivating. The native beans and teparies in the semi-arid and sub-tropical southwest to which Freeman, of the Arizona station, has called attention, grown perhaps for thousands of years by the aborigines, seem likely to prove timely crops for the dry-farmers of the southwest. Professor Freeman has isolated 70 distinct types of these beans and teparies, suggesting that many horticultural sorts may be developed from his foundation stock. The ground-nut, *Apios tuberosa,* furnished food for the French at Port Royal in 1613 and the Pilgrims at Plymouth in 1620, and as a crop for forests might again be used. There are a score or more species of *Physalis,* or ground cherries, native to North America, several of which are promising vegetables and have been more or less used by pioneers. *Solanum nigrum,* the nightshade, a cosmopolite of America and Europe, recently much advertised under several misleading names, and its congener, *Solanum triflorum,* both really wild tomatoes, are worthy of cultivation and in fact are readily yielding to improvement. *Amaranthus retroflexus,* one of the common pigweeds of gardens, according to Watson, is cultivated for its seeds by the Arizona Indians. In China and Japan the corms or tubers of a species of *Sagittaria* are commonly sold for food. There are several American species, one of which at least was used wherever found by the Indians, and under the name arrowhead, swan potato and swamp potato has given welcome sustenance to pioneers. Our native lotus, a species of *Nelumbo,* was much prized by the aborigines, seeds, roots and stalks being eaten. *Sagittaria* and *Nelumbo* furnish starting points for valuable food plants for countless numbers of acres of water-covered marshes when the need to utilize these now waste places becomes pressing.

The temptation is strong to continue this discussion of the domestication of native plants, but time demands that I pass to a consideration of the second potential of an increased diet, that of better distribution of the world's food-producing plants.

Beginning with the discovery of the New World, botanical and agricultural explorations have been carried on with zeal, and food plants have been interchanged freely between newly discovered lands and older civilizations. Yet in these centuries the food-plant floras of races have been changed but little. Quite too often a crop is found to be the monopoly of a race or nation irrespective of soil and climate, factors which ought to impose a cultivated flora. It would seem that agriculturists would quickly adopt food plants grown elsewhere of which the advantage is evident, and be thereby diverted from the cultivation of poorer crops in their own country. Yet the introduction of foreign plants is usually arrested, if not actually opposed, by the timidity of agriculture, and it has been most difficult to introduce new crops into

old regions. This conservation on the part of those who grow the food plants of the country is due to a universal dislike in the animal kingdom, most strongly developed in the human family, to eating unfamiliar foods. But travel is making all people less and less fastidious as to foods, as the numerous new foreign dishes in daily use in our own homes give evidence. Only savages and those who must struggle for sufficient food to sustain life live on one or a few foods.

Let us hastily run over a few foreign plants that may well receive more attention in America, naming fruits first as of most interest to this audience. Japanese plums and persimmons came to America in the medieval days of horticultural progress, and interest in them seems to have ceased. We need new importations of the many types not yet in the country. The fig is an ancient immigrant, but I am told that many desirable relatives were left behind. Date culture is now a most promising infant industry in the southwest. The Chinese jujube promises to be one of the most valuable of the many plants recently introduced into this country. The jujube is a hardy tree which has been cultivated in China for more than 4,000 years, being one of the five principal fruits of the new republic. There are hundreds of varieties differing in flavor and sizes, some growing less than an inch in length and others equaling the size of a hen's egg. One variety is seedless. Some kinds are eaten fresh, some are stewed.

Among the newest of the new on probation, but all clamoring for recognition, are the avocada from tropical America; the feijoa from Brazil; a dozen or more annonaceous fruits from the tropics, of which the cherimoya seems now to be most prominent; an edible Osage orange from Central China; the roselle, an annual from the Old World tropics, valuable for its fruit, stalks and seed. Several species of *Berberis* supply a refreshing fruit in northern Asia and might add variety to the rather spare fruit diet of the colder parts of this continent. Beside these are innumerable new citrus fruits, the number of species and varieties of which seem to be legion—the speaker is neither able to enumerate them nor to tell where they begin or where they leave off. Swingle's splendid work with this genus is one of the most notable contributions to horticulture in recent years.

The mango has long been grown in Florida, but interest in mangos has recently been renewed through the introduction of choice Indian varieties. Poponoe describes 312 varieties of mangos grown in various parts of the world, of which as yet I judge there are but few in America, though they are not difficult to grow in Florida, California or in our insular possessions. A quotation from Fairchild suggests the possible future of the mango in America. He says:

> The mango is one of the really great fruits of the world. . . . There are probably more varieties of mangos than there are of peaches. I have heard of one collection of five hundred different sorts in India. There are exquisitely flavored varieties no larger than a plum, and there are delicious sorts, the fruits of which are six pounds in weight. . . . These fine varieties, practically as free from fiber as a freestone peach, can be eaten with a spoon as easily as a canteloupe. Trainloads of these are shipped from the mango-growing centers of India and distributed in the densely peopled cities of that great semi-tropical empire.

No one can read Bayard Taylor's fervent praise of the durian and the mangosteen and not desire to grow these fruits in America. This is his panegyric on the durian.

> Of all fruits, at first the most intolerable; but said, by those who have smothered their preju-

dices, to be of all fruits, at last, the most indispensable. When it is brought to you at first, you clamor till it is removed; if there are durians in the next room to you, you can not sleep. Chloride of lime and disinfectants seem to be its necessary remedy. To eat it seems to be a sacrifice of self-respect; but, endure it for a while, with closed nostrils, taste it once or twice, and you will cry for durians thenceforth, even—I blush to write it—even before the glorious mangosteen.

Listen to his laudation of the "glorious mangosteen."

Beautiful to sight, smell and taste, it hangs among its glossy leaves the prince of fruits. Cut through the shaded green and purple of the rind, and lift the upper half as if it were the cover of a dish, and the pulp of half-transparent, creamy whiteness stands in segments like an orange, but rimmed with darkest crimson where the rind was cut. It looks too beautiful to eat; but how the rarest, sweetest essence of the tropics seems to dwell in it as it melts to your delightful taste.

One need not titillate the palate to enjoy such fruit. Can they be so delectable? Surely we can find a place for them somewhere in America.

Let us turn to a few examples of promising vegetable and farm crops of foreign countries not yet cultivated in the United States. Only those which give most emphasis to the present paper can be mentioned.

All know that rice furnishes the chief food of China, but few are aware that sorghum is as important a crop in Asia as rice and that it is the chief food of a large part of Africa. In China not only are the stalks of sorghum used, but bread is made from the seeds. In parts of India, sorghum is the staff of life. The Zulu Kaffirs live on the stalks, which are chewed and sucked, and Livingstone says "the people grow fat thereon." The several species of yams constitute one of the cheapest and most widely distributed food plants in the world, yet the yam is little grown in America. Several genera of Aroideæ, as *Caladium, Alocasia, Colocasia* and *Arum,* each with innumerable varieties, furnish taro, arrowroot, ape and other more or less familiar food to the South Sea islanders. In a bulletin from the United States Department of Agriculture, under the title, "Promising Root Crops for the South," these Aroids, called under their native names of yautias, taros and dasheens, are recommended as most valuable wet-land root crops for the South Atlantic and Gulf States. Of the place of the cocoanut in the world's economy I need not speak. Varieties of *Maranta* were grown in Mississippi and Georgia in 1849, but disappeared. From one of the several species of this genus comes the arrowroot of commerce. Arrowroot is a favorite food of the Feejees and their neighbors, as well as of the inhabitants of Cape Colony, Natal and Queensland. May not arrowroot some time be produced profitably in America? The banana has been on our tables less than a generation, yet it is now one of the commonest foods. There are several species and many varieties yet to be introduced into the tropics of America. The leaves and buds of several agaves furnish an abundant and a very palatable food to our southern neighbors. From plants of the large genus *Manihot* of equatorial regions, tapioca is made under conditions which could be greatly improved. As cassava, one of these manihots is already important in the United States and may some time compete with corn and wheat in the food supply of the country.

To quench the thirst of the teeming millions in time to come there may be a multiplicity of beverages as well as of foods to mitigate hunger. In Arabia several millions of people drink khat, while in southern South America as many more millions allay their thirst with maté. Maté, according to Fairchild, can be produced

at but a fraction of the cost of tea and supplies the same alkaloid in a more easily soluble form. Both contain thein, the active principle in "the cups that cheer but not inebriate." Sturtevant names twelve plants the leaves of which are used in different parts of the world to adulterate or in place of tea. We have but just acquired the use of cocoa and chocolate from the natives of our American tropics and of cocacola from the negroes of Africa, and it is not unlikely that we shall find other similar stimulants. For drinkers of more ardent beverages, if King Alcohol continues to reign, there is an abundance, the diversity and cheapness of which probably will ever as now be regulated by taste and taxes.

Time prevents my naming other valuable foreign plants that deserve to be tried in our agriculture. It is fortunate for American farming that men from the United States Department of Agriculture are now searching everywhere for new material. Saul went in search of asses and came back with a crown. So these men sent to foreign countries for material, possibly commonplace enough, are bringing back treasures the value of which in many cases will be incalculable. Introduction of seeds and plants for the nation is work to which the institutions represented here should lend aid in every way possible.

The last of the three means of developing plants for food, and as I believe the most important, is by using either foreign species or wild native species to hybridize with established crop-plants. It needs but a brief statement of what has been accomplished in increasing hardiness, productiveness, disease resistance, adaptability to soil and other essentials of standard crop-plants, to show that through hybridization of related species we have probably the best means of augmenting our diet. Let us glance at a few recent accomplishments of hybridization, noting chiefly results with horticultural plants.

Downing in 1872 described 286 varieties of 4 species of plums. In the 40 years that have elapsed the number has increased to 1,937 varieties representing 16 species. Now the significant thing is that whereas Downing's plums were pure-bred species, 155 of the present cultivated plum flora are hybrids between species. Downing could recommend plums for only a few favored regions. Some kind of plum can be grown now in every agricultural region in North America. Even more remarkable is the part hybrids have played in the evolution of American grapes. At the beginning of the nineteenth century, the grape could not be called a cultivated crop on this continent. Now there are 16 species and 1,194 varieties, the most significant fact being that 790 or three fourths of the total number are hybrids. The grape through hybridization has become one of the commonest cultivated plants. The genus *Rubus* promises to attract and distract horticulturists next. As nearly as I can make out there are about 60 species of *Rubus* in North America. In the two completed parts of Focke's "Species Ruborum," 273 species are described. Raspberries, blackberries, dewberries and their like hybridize freely and we already have in the loganberry, the purple-cane raspberry, the wineberry and in the blackberry-dewberry crosses valuable fruits. If any considerable number of Focke's several hundred species can be similarly mixed and amalgamated, the genus *Rubus* will be one of the most valuable groups of fruits.

The speaker is studying cultivated cherries. When the work began a few years ago about a score of species were in sight. Koehne, a recent botanical monographer of the sub-genus *Cerasus,* to which

our edible cherries belong, describes 119 species, many of them but recently collected by Wilson in Asia. There are enough hybrids between species to indicate that cultivated cherries will some time be as diversified as plums and with quite as much advantage to the fruit.

Webber's and Swingle's work in breeding hardy citrus fruits; blight-resisting pears as a result of crossing *Pyrus communis* and *Pyrus sinensis;* Burbank's spectacular hybrid creations; the diversity of types of tomatoes, potatoes, egg-plant, peppers, beans, cucurbits and other vegetables, not to mention roses, chrysanthemums, orchids and innumerable flowers, suggest the possibilities of hybridization. We have not done what lies within our reach in crossing cereals—corn, wheat, oats, rye, buckwheat, the last especially, remain yet to be touched by the magic wand of hybridization. Hybrid walnuts, chestnuts, hickories and oaks, promise a wonderful improvement in nuts.

Truth is we do not know how much nor what material we have to work with in many of the group of plants I have named, lending color to the saying that the plants with which man has most to do and which render him greatest service are those which the botanists know least. This brings me to the last division of my subject.

Nothing is more certain than that we are at the beginning of a most fertile period in the introduction of new and the improvement of old food-plants. Yet agricultural institutions are most illy prepared to take part in the movement. "Art is long and time is fleeting," can be said of no human effort more truly than of the improvement of plants, and haste should be made for better preparation. Looking over the material that is usable in agricultural institutions, it seems that we are sadly lacking in the wherewithal upon which to begin. It is indispensable for effective work that we have an abundance of material and that we know well the plants with which we are to work.

How may the material be had? We are fortunate in the United States in having the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture for the importation of foreign plants. This office has effective machinery for the work. It maintains agricultural explorers in foreign countries. It is in direct contact with the agricultural institutions of other countries as well as with plant-collectors, explorers, consuls, officers of other countries and missionaries. Through these agents it can reach the uttermost parts of the world. Moreover, it has trained men to identify, to inventory, to propagate and to distribute foreign plants. This office can better meet quarantine regulations than can private experimenters or state institutions. All interested in foreign plants ought to work in cooperation with the Office of Foreign Seed and Plant Introduction of the Department of Agriculture.

To be used advantageously material must be near at hand. This means that there must be botanic gardens. There should be in every distinct agricultural region of the country a garden where may be found the food plants of the world suitable for the region. It is strange that in the lavish expenditure of state and federal money in the agricultural institutions of the land, that so little has been done to establish and maintain comprehensive plantations of economic plants. Now that the amelioration of plants is a part of the work of agricultural colleges and stations it would seem that the establishment of such gardens is imperative. True, there are botanic gardens, but the museum idea is dominant in most of them—they contain the curiosities of the vegetable kingdom, or they show the

ornamental and beautiful, or they are used for purposes of instruction. We need agricultural gardens in which agricultural plants are dominant rather than recessive.

There is another difficulty quite as detrimental to progress as inability to obtain material. It is the lack of trustworthy information in regard to economic plants. Quite as necessary as agricultural gardens is an agricultural botany. In this botany must be set forth, besides descriptions of species, the habitat, the migrations, the geographical relations to other plants, the changes that have occurred, how the plant is affected by man-given environment, and all similar data. Physiological facts regarding germination, leafing, flowering and fruiting must be given. The production of such a book is a consummation devoutly to be wished. At present the information needed is best supplied by Bailey's splendid cyclopedias, but there is need of more historical and biological knowledge in agricultural botany.

I had thought to say a few words about the men who are to do this work. Material and books do not create. The man has not been lost sight of, but I should have to set forth his temper and training too hurriedly even if I could properly conceive them. But from the beginning to the end of this new shaping of food crops, the individual man trained for the work will be dominant. The work to be done, however, is so vast that we can not make an appreciable showing unless the task be divided among a great number of workers. Those who will do most are such as can concentrate on particular problems the sifted experience and knowledge of the world. Many may sow, but only the strong can garner.

There should be unity of action to avoid waste. What more pathetic spectacle than that of isolated men in our agricultural institutions attacking one and the same problem in which they duplicate errors and waste their efforts in what too often proves with all to be petty circle-squaring. Much of this appalling waste can be avoided by a proper spirit of cooperation. By all means let us cooperate in the amelioration of plants.

In conclusion, I must end as I began by calling attention to the great probability of a near-at-hand deficiency of food. I must again urge the importance of making use of every means of increasing the supply. I have tried to call attention to the desirability of growing a greater number of food-plants as one of the means. Not to attempt to develop and utilize to its highest efficiency the vast wealth of material in the plant-kingdom for the world's food is improvidence and is a reckless ignoring on your part and mine of splendid opportunities to serve our fellow men. It is my hope that the horticultural departments of the agricultural colleges and experiment stations of North America, represented by members of this society, may become active agents in increasing the number of food crops and thereby the world's food supply.

U. P. Hedrick

HEADSHIP AND ORGANIZATION OF CLINICAL DEPARTMENTS OF FIRST-CLASS MEDICAL SCHOOLS[1]

Two recent official manifestations with reference to the problem of full-time clinical positions deserve to be put at the head of our

[1] This manuscript has been prepared for the president and trustees of a university in answer to the following questions:

"First: What should be the relation of the hospital to a first-class medical school? The question is asked . . . to bring out the ideal relationship. For instance, to what extent should the school own, control, or manage its teaching hospital in its medical and in its administrative functions.