Fruit Insect Problems of the Past and Next 100 Years

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In the observance of a centennial or like event, it is customary to review the progress that has been made in fields related to the central theme of the occasion, to assess their present status and to indulge in some speculations about the future. I shall attempt such coverage for the field of orchard pests and their control.

My comments will be related to New York conditions and primarily to apple. While much of what I say here may be as applicable to the other tree fruits as to apple, it was deemed most practicable to build the account around a single fruit and to the most important one grown in the state. That of course would be apple.

I. THE PAST 100 YEARS

More progress was made in orchard pest control during the life of this Society, that is, in the past 100 years, than in all of the 6000 preceding years of man's recorded history. That is a safe statement to make because we had no effective man-devised control measures until pesticidal spray treatments came into general use. And that took place only about 60 years ago. Prior to this time insects and diseases were allowed to feed and develop freely, and essentially without interference from the grower. In consequence, pests such as the canker worms and the tent caterpillar periodically defoliated their trees and the codling moth and plum curculio often took heavy tolls of their crops.

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I should not leave the impression that early orchardists made no attempt to control pests or that all of the practices proposed were wholly ineffective. Many remedies were suggested and presumably were tried out. A few had some merit. These included: the practice of pasturing farm animals in orchards which resulted in the destruction of windfall fruits infested with codling moth and apple maggot; the capture of plum curculio adults by jarring them out of the tree onto a cloth placed underneath; and the banding of the tree trunks with sticky barriers to trap the wingless female moths of canker worms.

Fruit growing without spraying. In spite of the lack of chemical spray protection early fruit growers were able to produce usable crops most seasons and some that were of excellent quality. How was this possible, you may well ask, knowing how rapidly apple orchards "disintegrate" today when we stop spraying them: There are several explanations.

First, growers had fewer pests in 1855 than we have today. Since then we have added a number of foreign species including the San Jose scale, European red mite, rosy apple aphid, Japanese beetle and oriental fruit moth. Also many native species did not become troublesome until relatively recent times. Some of these are: the apple maggot, cherry fruit flies, grape berry moth and red-banded leaf roller.

Isolation was also a factor. Early orchards were small and widely scattered. In consequence, some escaped damage temporarily at least, simply because of the slow rate of pest spread from one orchard to another.

Another important consideration is market standard differenees. The consumer then was much more tolerant of insect and disease blemishes on fruits than we have educated him to be today. Thus the presence on a fruit of a few spots of apple scab or insect feeding scars was not considered objectionable, especially if all fruit available was more or less similarly afflicted. Even in the case of a wormy apple one could usually eat around the worm hole successfully.

Differences in cultural practices and the varieties grown are also factors. Early orchards were seldom pruned or intentionally fertilized. True, the droppings of farm animals pastured in some plantings furnished some nitrogen, but not much. For the most part pioneer orchards were maintained in a relatively "hard" growth condition. This we know tends to reduce the extent and intensity of pest damage especially that of sucking insects and of apple scab. Similarly, many of the apple varieties grown were firm winter sorts—kinds that keep well in common storage. Often these varieties are less seriously damaged by insect pests and diseases. Certainly this is true when compared with some of our modern favorites like McIntosh and Cortland.

Finally, we should appreciate that our present day spray treatments are toxic to many of the parasitic and predaceous species of insects and mites. Thus growers of pre-insecticide times got much more help from these natural enemies in pest control than we do today.

To sum up: the "good old days" were neither quite as good as some would have us believe, or, quite as bad as we might have imagined them to be in the absence of spray protection. However, one would not remain in business long today if he attempted to grow fruit as they did in 1855. Neither present day pest problem nor market requirements would permit it.

Spraying practice begins. Orchards were virtually unsprayed prior to 1880. A little Paris Green was used in the seventies to combat canker worms but this usage occurred mostly in the Mid-West. A New Yorker,* however, is given credit for first reporting that the codling moth could be controlled by spraying. In 1878, E. P. Haynes who

* Probably credit should be shared with an Iowa grower, J. M. Dixon, who in 1878 used London Purple to control canker worms and like Mr. Haynes found he got control of the codling moth along with the canker worms. For other details on the material given in this paragraph see: E. G. Lodeman: The Spraying of Plants. pp. 62-4. 1896. Macmillan and Co., New York.

lived near Hess Road in Niagara County treated part of his orchard with Paris Green to control a canker worm infestation. Not only did he control this pest but the codling moth as well. J. S. Woodward, a prominent horticulturist who had advised Mr. Haynes to use the Paris Green, saw the results and reported them to this Society at its January 1879 meeting. He was not believed. To quote him "I was jumped upon as a crank."

In spite of favorable reports like the foregoing, nearly twenty years elapsed before spraying became a general practice. This is not long in view of the revolutionary nature of the step taken. For, consider the situation that existed in 1880: Very little was known about the biology of insect pests and organisms causing plant diseases. Certainly this information was insufficient to enable anyone to develop intelligently arrived at control measures, based either on the use of chemicals or other means. No satisfactory fungicide existed. And the insecticides available were about limited to three: kerosene emulsion, Paris Green and London Purple. Spraying equipment consisted of hand syringes for the most part, forerunners of our present bucket pumps. It is evident, I think you will agree, that chemical pest control hardly existed as a practice at this time. But latent forces were at work.

One product of this ferment was the establishment of Agricultural Experiment Stations. Our two, the Cornell University and New York State (or Geneva) Stations became operative in 1879 and 1882, respectively. Some time elapsed before these institutions got their program underway and succeeded in dispelling at least some of the skepticism of practical people that farm problems could be solved through science. One of the early successes they scored was in the field of orchard pest control. For it was the Experiment Stations that supplied the necessary information on the biology of the pests and diseases and the scientific evidence on what would and would not work in control that lead to grower-adoption of pesticidal spray treatments. This practice became fairly general in New York orchards by 1895.

Essentially coincident with the birth of the Experimental Station idea was the accidental discovery in France of the first really effective fungicide. This came to be known as Bordeaux mixture. It was introduced into this country in 1885 and soon became the standard treatment for the control of apple scab and of many other fungous diseases of plants.

And in response to a growing demand for better spray application equipment, pump and other manufacturers got busy. First to be introduced were man-operated spray pumps. The typical outfit was horse-drawn and consisted of a pump mounted on a barrel. One man would pump and drive while another, using a 10-12 foot spray-rod, would spray. Some of this equipment was quite good and continued to be used in small plantings well into the twentieth century. But hand pumping is hard work. Therefore, interest remained keen in the development of equipment powered by some force other than that generated by man. First, rigs were introduced which were operated by horsepower (through traction), then steam engines of which the first appeared in 1894 and finally, around 1900, the first gasoline or internal combustion engines. This last introduction was to have far reaching effects, not only in orchard pest control practices, but on our whole economy.

San Jose scale. An important event occurred about halfway in the past century. This was the appearance of the San Jose scale. This insect was first found in New York orchards in 1894 and soon became a major pest. All interested persons and agencies joined forces to cope with this new threat to the fruit industry and by about 1906 the situation was essentially in hand. The insect continued to be a problem in New York long after this time but by about 1906 it had passed the crest of its period of greatest activity. To a young man at the Geneva Station went the principal credit for working out practical measures for the control of San Jose scale in the Northeast. This was the late Professor P. J. Parrott. He established that both lime sulfur and oil sprays could be used successfully to control this pest.

A consequence of the concerted drive to suppress the San Jose scale was an over-all improvement in the spraying practice. Growers learned that to control this pest they had to spray more thoroughly than had been their custom. This lead to the finding that thorough spraying also gave better results against apple scab and the codling moth. The desire to get better spray coverage stimulated interest in having more powerful and efficient spraying equipment. Equipment manufacturers quickly responded to this need and saw to it that such machines were made available. San Jose scale was also responsible for the addition of lime sulfur and petroleum oils to the then meager arsenal of pesticides.

Steady if not very spectacular progress was made after the excitement over San Jose scale subsided. Paris green gave way to the safer lead arsenate. Lime sulfur which had been used at strength sufficient to kill San Jose scale in the dormant period was found, in 1908, by A. B. Cordley of Oregon, to be usable in a dilute state as a foliage spray. It soon replaced Bordeaux mixture for apple scab control and thereby eliminated fruit russeting caused by the copper material. Spraying equipment got increasingly better. One important advance was the introduction in 1911 (John Bean Mfg. Co.) of an efficient pressure regulator for the hydraulic spraying machine universally used at this time. Another improvement was the spray gun, first made available in 1914 (Friend Mfg. Co.)

Dusting vs. spraying. The question of whether orchard pests could be more effectively and economically controlled with pesticides applied as dusts or as sprays underwent trial on a gigantic scale starting about 1915 and continuing throughout the twenties. It all stemmed from dust vs. spray experiments conducted by the Experiment Stations between 1912 and 1915. Gradually thereafter the question of whether one should dust or spray became an important issue. New York was the principal testing ground of the question and eventually growers and other interested persons became more or less divided into opposing camps.

Numerous comparisons were made between spraying and dusting by research workers and others and finally by a large number of growers. While this was going on the issue was discussed, argued and debated on innumerable occasions. Ultimately neither principle won a complete victory. However, spraying did become the preferred method, occasioned as much as anything by the upsurge of the codling moth in the thirties and the need to lay down heavier pesticide deposits on the fruit than could be obtained with dusts. Dusting found a place in special situations and in larger operations as a supplement to spraying in apple scab control.

We all appreciate that orchard dusters and the type of spraying machine used in the dust vs. spray struggle (high pressure hydraulic outfits) were both largely superceded by our present outlet air-blast sprayers.

Spray Information Service. During World War I young men were sent out by the College of Agriculture to the important fruit and vegetable growing counties of the state to help growers there in the control of their insect and disease problems. This was part of a war inspired effort to increase food production. This pest control service was so much appreciated by growers that at war end they petitioned the College to continue it. This was done and the effort eventually became oriented into the Extension Service program where it will be found today.

The Spray Information Service as it is commonly designated was a new concept. Largely through its efforts New York fruit growers probably became the best informed group, pestwise, of any comparable group in the world. Others may have caught up in the past decade or so but we in New York pioneered the idea. Over the years of its existence the Spray Service has steadily grown in usefulness and has attempted to adjust to changing conditions. Thus the telephone relay has given way to the radio for the timing of spray applications. Next, I suppose, television will replace radio for this purpose.

Codling moth, apple maggot and **fruit washing.** Around 1930 we became aware that the codling moth was becoming increasingly difficult to control in some orchards. This we learned was caused by the development of strains of the insect that were resistant to lead arsenate, the insecticide in general use for codling moth control at that time. As time went on, more and more orchards became involved. Also the problem tended to worsen in plantings first to experience difficulty as the degree of resistance increased. To meet this challenge growers increased the gallonage of spray applied per tree, combined nicotine with the lead arsenate and added such supplements as spreaders, stickers and deposit builders. Still the situation was not relieved. It seemed—and there was some foundation for this belief in fact—that the more one sprayed the more one had to spray.

These were troublous times for New York apple growers. Aside from the need of some to apply additional and more thorough sprays for codling moth control, prices were low — for these were depression years — and two new problems entered the picture. These were: apple maggot and spray residue restrictions.

The apple maggot problem came to

the fore with the imposition of a requirement by Great Britain that apples infested **in any degree** would not be admitted to their country. This set off a chain reaction and soon all foreign and domestic markets became highly apple maggot-conscious. Measures needed to provide the near perfect degree of control required were eventually worked out and adopted by the growers. But this meant more and later spraying, especially in eastern New York where the apple maggot always has been more troublesome.

The crowning blow of all, however, was the need that arose for the washing of fruit that bore excessive lead arsenate spray residues. This was an unpopular requirement. In fact, affairs reached a state at times approaching open rebellion against the practice. Washing was a messy, costly job. Frequently too, where soft varieties like McIntosh were involved, the washing operation bruised the fruit and often greatly lowered its market value.

Somehow, however, most growers hung on. Prices got better. And finally in 1945 DDT became available. By comparison with lead arsenate, DDT gave miraculous results against codling moth. The insect seemed to yield alike to good, bad and indifferent spraying practices. So, for the time being at least, we were provided with relief from a pest problem that in the thirties had directly or indirectly forced some growers out of business.

Oriental fruit moth. Peach and quince growers acquired a serious new fruit infesting pest around 1928 with the appearance of the oriental fruit moth. I have singled out this pest for special comment because it represents our first venture into the serious employment of parasitic insects for the control of one of our major fruit pests. In general the effort gave good results. True, the parasites did not eliminate wormy peaches, and, in some years and in some orchards, control fell below desirable commercial standards. DDT, when it became available, quickly replaced parasites for the control of the oriental fruit moth in peach orchards. Now parathion and other organophosphates have largely superceded DDT.

DDT and air-blast equipment. This next period in the development of pest control practices extends up to the present day. It had its beginning with the introduction of DDT in 1942 (first used in our orchards in 1945) and might be called **the organic pesticide era.** DDT triggered off phenomenal development that has witnessed the introduction of a long list of synthetically prepared pesticidal chemicals. These have been so good that collectively the organics have largely replaced the materials in use prior to 1942. While our position in pest control has been greatly improved by the introduction of these new chemicals, their use has not proved an unmixed blessing. For example, while DDT enabled us to get excellent control of the codling moth—until recently anyway—it probably should be blamed, basically, for our increased trouble with mites and the red-banded leaf roller. Thus, we have done some trading of new problems for old. On balance, however, we are much better off with the organics.

While the foregoing developments were taking place, equally important advances were being made in the field of application equipment. Demands arose for machines that speeded up spraying time, that could be operated with less manpower and, in general, reduced the drudgery of the spraying job. These objectives are fairly well met in our present day outfits that use the air-blast principle and spray mixtures in a semi-concentrated (3-4X) state. Thus, one man can operate such machines from his position as tractor driver and treat upwards of a hundred acres of orchard in a day.

Present status. Now a brief summing up of where we stand today in pest control. As you know, we now depend almost exclusively on the use of chemical sprays for insect and disease control. Generally such programs are quite effective but some growers feel their cost is too high. That last may be true. But I am sure none of us in the College has any intention of advising more treatments than are needed to produce good yields of saleable fruit. You growers wouldn't go along with us if our recommended spray schedules were unrealistic in this regard. Unless a grower meets these basic yield and quality conditions, however, he won't remain in business long.

Anyway, costs are relative things. When fruit prices are low, spraying and all other production costs may be too high, relatively. Pest control costs have become fairly well stabilized. We can't say as much for the prices we receive for fruit crops to date. This is one area where reasonable stability can, and I believe will, come in the years ahead. Surely it should be within our ability to control the economic "bugs" that afflict our fruit industry as well as we have those of a biological nature—the insects and diseases.

Aside from cost, pesticide resistance, human health hazards and fruit quality impairment are some of the other problems that attend the use of chemical control as it is presently being employed. 1) **Pesticide resistance** has not as yet become a serious factor in New York orchards. Some plantings now harbor phosphate-resistant strains of the European red mite. In others, codling moth populations are beginning to show some DDT resistance. But as just stated, pesticide resistance is not a serious general problem in our orchards at present. However, trouble of this nature is bound to increase in the years ahead. 2) We should recognize that certain **human health hazards** may be present in the use of chemicals as toxic as are most pesticides. Involved are both those who apply the materials and all of us as consumers in eating treated food. As you know, this problem is being regulated by the Food and Drug Administration. The latest development in this field was the enactment of the Pesticide Amendment to the Food, Drug and Cosmetic Act (The Miller Bill) which became effective in 1955. In spite of present uneasiness over the restrictions on pesticide use that may be imposed by this new law, I doubt it will create any unbearable difficulties for fruit growers in the years ahead. This is necessary regulation. 3) Occasionally pesticides may impart and diseases from our orchards by the off-flavors or otherwise **affect fruit quality** unfavorably. These effects must be detected as early as possible of course, and the offending product either eliminated or cleaned up. This consideration is especially important where the crop is destined for processing.

II. THE NEXT 100 YEARS

Doubtless we shall witness advances in the control of orchard pests within the next 100 years that will be fully as great, relatively, as those of the past 100 years. I see no likelihood, however, that we will have eliminated insects year 2055. On the contrary, pest problems and the side problems created by the use of various control measures are expected to constitute as large a total problem then as they do today. They may be larger.

Insects in the more than 250 million years of their existence on this earth have shown a remarkable capacity to adjust and adapt to changing conditions. Recent evidence of this fact is the development of pesticide resistant strains. Once, for example, we thought we would be able to exterminate the housefly with DDT. In a very short time, however, races of the fly developed that became virtually immune to this once potent killer. We may be on the threshold of a similar development with the codling moth.

It is reasonable to expect that we shall continue to be able to keep pests well under control in localized areas as in a cultivated field or in an orchard. But for the foreseeable future I doubt that we are going to be very successful in the outright elimination of species. Our record to date in this area anyway is not impressive. For, of the estimated more than one million species of insects and mites now resident on this earth man with all of his efforts has not succeeded in eliminating even one species.

Before we consider the future of orchard pest control it will be helpful, I believe, to try to envision the future of the fruit industry itself. Thus, we should have some idea of whether we will be dealing with the pest problems: of a dynamic growing industry or of a declining one; of crops that increasingly will be destined for processing plants or those that will be sold in large volume as fresh fruit; of fruit production that will be limited to commercial growers or that which will include many amateurs. Suppose we look at each of these points, briefly.

We can learn something about the probable future size of the fruit industry by projecting fruit consumption trends against the expected increase in our population. A projection of this nature for apples is given in Figure 1. This graph is based on federal records** on the total commercial apple crop of the United States (fresh and processed) and the latest population records and estimates of the U. S. Census Bureau.

As you will see I have made two per capita consumption projections, labelled **present trends** and **predicted course.** My meaning here is perhaps evident. It is that if we continue to grow, and especially to market, apples as we are and have been doing, then the per capita consumption may well follow, approximately, the course shown in the **present trend** curve. Personally, I believe we will be able to do better than this. My prediction of how much better is shown in the **predicted course** curve.

You may be interested in having the specific figures in my "guesstimate" of Figure 1. First, the per capita consumption levels in the year 2000 were 8.5 pounds for the **present trend** line and 20 pounds for **predicted course.** Using these rates, a crop of 110 million bushels as the present normal United States apple crop and a population of 300 million people in the year 2000 we arrive at these figures: a 53 million bushel crop in 2000 for the **present trend** curve or 125 million bushels for the **predicted course** curve. Percentagewise the former figure would be 48% of todays apple crop, the latter, 114%.

Which of the foregoing guesses will

** Agricultural Statistics. 1952 (USDA Publication).

prove nearer correct? That will be determined mostly, I believe, by how successful we will be in solving the basic marketing problems that affiict the industry (It's a matter of learning to control those economic "bugs" I referred to earlier). The obvious need is to develop means whereby the grower can deal with the buyers of his produce on a near equal bargaining basis. The Chautauqua-Erie County grape growers offer a good example to the rest of the fruit industry of how to set up and handle the marketing part of their business.

Turning now to the question of processed vs. fresh fruit. Undoubtedly there will be a continuing and growing demand for fruit in various processed forms. However, fresh fruit demands could hold up well too. It is a matter of proper merchandising. Fresh fruit, particularly apples, would again become a popular item if people could purchase small lots of high quality unbruised fruit, get it home in that state through proper packaging, and be taught how to keep it thereafter, without deterioration, until it is consumed. A few growers are doing a fairly good job in this direction. Probably this goal will not be reached in important volume, however, unless grower-controlled central marketing agencies are established.

The revelance of the foregoing to pest control is this: where crops (apple) are to be sold as fresh fruit a more exacting spray program will have to be used than in situations where the fruit will end up as slices, sauce or juice. In the former instance the goal is the production of fruit of high surface finish and freedom from all pest blemishes; for processing, one seeks high volume primarily, and fruit finish often is a secondary consideration.

Whether amateur interest in fruit growing will increase or not may well hinge on what the Entomologists and Plant Pathologists can do to provide simple fool-proof means to control pests. Progress has been made in this direction within recent years but we need to go much further. We can expect with future improvements in transportation to find more and more interest on the part of city workers to have their homes and an acre or two in the country. Many of these city-country people will want to grow fruit. And if pest control can be made relatively easy for them fruit growing by amateurs may well become an important consideration in the total fruit production picture of the future.

Summing up: I believe we will have a larger apple and deciduous fruit industry in 2055 than we have today and it will be one that will average out to be of higher quality. While a large percentage of the fruit crops will be made available to the consumer in various processed forms there will be a strong demand too for fruit in its natural state. I further predict that fruit growing by amateurs will increase in popularity and in participation.

Now that we have established, to my satisfaction anyway, that we are going to have a strong fruit industry in the future, how much and what kind of pest control servicing will it need? First, suppose we consider the future for pesticidal chemicals.

Future pesticides. We should be able to develop safer pesticides than we have today. They will possess selective toxicity, that is, be toxic to pests but relatively harmless to man and to warm-blooded animals. We should also be able tc reduce the number of spray treatments needed in a season by use of systemic pesticides. Properly these materials enter the sap stream and thereafter, for a variable period, kill mites and insects, particularly sucking types, that feed on this pesticide-laden sap. We know that demeton, a present day systemic, may give protection against mites and aphids in this way for a period of 2-3 weeks. Maybe we can look forward to the availability of systemics that in a single treatment will immunize a fruit tree against insect and disease injury for an entire growing season and do this with the harvested crop being safe from a human health standpoint.

As we learn more about insect physiology we should be able to effect pest control by subtler means than through the use of the highly toxic chemicals of today. I expect pesticides to be developed that will be relatively non-toxic in the usual meaning of that word but will have the property of "throwing a switch" so to speak, in some vital life process of the pest. Thus such chemicals might prevent reproduction, or induce death through malnutrition. There are many possibilities. That ingeniously designed rat killer, Warfarin, is the kind of product I am thinking of. The indirect means of pest control suggested here may not produce the spectacular immediate effects we get with some present day chemicals but the results would be surer and the materials less hazardous to use.

Pesticide resistance will become an increasingly common and trying problem in the years immediately ahead. A temporary solution of this problem of course lies in the substitution of new materials as the old ones wear out. But this treadmill prospect is unsatisfactory from a long range standpoint. As we learn more about how various pesticides kill insects we should be able to develop some that will be essentially resistance-proof. As a matter of fact we have several pesticides now that seem to possess this property. I refer to petroleum oils, the pyrethrins and rotenone.

Pesticide - conditioned parasites. Many of the pesticidal chemicals we use today are as toxic—if not more so—to the parasitic and predaceous insects and mites as to the pest species. This is unfortunate. For by eliminating these natural enemies we deprive ourselves of a potent ally in control. Also pests when freed of this natural restraining force and the competition of other pest species often attain levels of abnormal abundance. Primarily this accounts for our recent troubles with the red-banded leaf roller and the various species of mites.

Ideally it would be fine if we could devise ways to use both principles of control—chemical and biological. Maybe we will be able to do just that. Two ways of attaining this goal come to mind. One is to use or develop pesticides that would be so selective in their nature as to control the pests and spare the parasites and predators. That seems like a large order. Dr. A. D. Pickett in Nova Scotia, however, has been exploring the possibilities in this field and has come up with some interesting results. I am rather skeptical about the full applicability of this principle under New York conditions. However, it should not be stricken from the possibility list.

I am very much intrigued with another idea in this field. It is: why not pesticide-condition the parasites and predators? If pestiferous species can survive chemical control by developing pesticide resistant races why isn't this possible for the natural enemies? Workers in Canada have already demonstrated that races of the oriental fruit moth parasite, **Macrocentrus**

ancylivorous can be developed that are DDT resistant. This may well become a future job for the Experimental Stations: the breeding up and release of pesticide-resistant parasites and predators.

Application equipment. The means of applying pesticidal treatment will applying pesticidal treatments will undoubtedly undergo changes in the years ahead as new engineering principles are developed. Maybe we'll come to rely heavily on aircraft to do the job. Another possibility is the installation of a semi-permanent spraying system in the trees. This might permit something approaching a push-button spraying operation. Such a set-up could be used, in adition to the application of pesticides, to apply fertilizers, growth hormones or even water for irragation. A spraying system of this nature would enable us to get complete spray coverage in all parts of the tree. We do not achieve this goal with the machines in use today. Generally we get by pretty well with this coverage except against pests like the red-banded leaf roller, mites and DDT-resistant codling moth. Should any of these pests become a little more active—such as through the development of resistant strains—we may be in for trouble. I doubt we will continue to depend indefinitely on these big mobile rigs of the present. Maybe they are headed for the same fate as the dinosaur—too big and heavy for this earth.

Atomic energy. No speculation on the future would be complete today unless some consideration is given to the impact of atomic energy on the field. Unquestionably great new possibilities for good and evil have now been opened to mankind through the availability of energy from the atom. However, it does not necessarily follow that this new force will have direct applications in the solution of pest problems in our orchards. Electricity for example has been available to us for a long time but how much use have we made of it to control insects? Very little, really. However, I would be surprised if atomic energy did not have some fairly direct applications.

Radioisotopes are already being used as a research tool in biological and physiological studies on insects. It is through work of this nature that we shall acquire the information needed to develop genuinely better, and safer pesticides and get around the pesticide resistance problem. Radiation genetics also has possible applications in orchard pest control. You have already heard earlier in this program how the fruit breeders hope to make use of this principle to develop new varieties.

An additional application of atomic radiation as a control measure was demonstrated by U. S. D. A. workers recently against the screw-worm fly. Through the release of radiation sterilized males of this insect they were able to eradicate this cattle pest from the island of Curacao in the Caribbean. No offspring resulted from the mating of these males with wild female flies. The pest simply "bred" itself out of existence. Whether this same principle could be used successfully against any New York fruit pests is uncertain. However, the idea is highly intriguing.

I would like to say in conclusion that I have every confidence in our collective ability to improve on the practices we now employ in orchard pest control and to find satisfactory means of coping with any new problems that may arise in the field in the future. I believe this because of my profound belief in research. Its possibilities are virtually limitless. As fruit growers, it will be to your interest to give research your greatest possible backing. It will need continuing support because dealing as we are with living organisms, few problems can be expected to remain permanently solved. I wish I were as confident about our ability to solve future pest problems as those that lie in the area of marketing and economics. Certainly it is possible to solve them and I'm inclined to think we will at least to the extent of keeping the fruit industry in a sound and growing state.

In this account I have ventured to make some prediction about pest problems of the future and the means we may use to handle them. These forecasts may or may not prove correct. After all no one can readily know what the future may hold in store for us. I am downright confident, however, about one prediction. It is this: regardless of how much progress will be made in the next 100 years in the area of pest control and in all others, I am sure it will not result in the establishment of a problemless world.

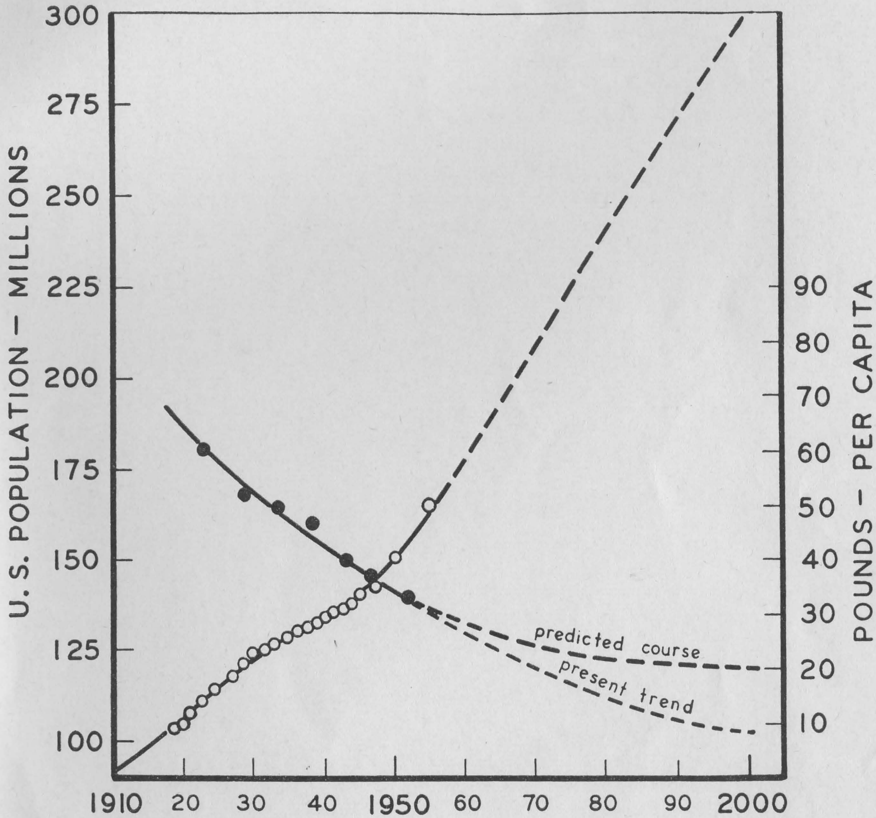

FIG. 1. Relationship of the predicted U. S. population 1956-2000 and two possible per capita consumption rates for apples. (Points on the latter curve are 5-year averages.)