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The Hunt Institute for Botanical Documentation, a research division of Carnegie Mellon University, specializes in the history of botany and all aspects of plant science and serves the international scientific community through research and documentation. To this end, the Institute acquires and maintains authoritative collections of books, plant images, manuscripts, portraits and data files, and provides publications and other modes of information service. The Institute meets the reference needs of botanists, biologists, historians, conservationists, librarians, bibliographers and the public at large, especially those concerned with any aspect of the North American flora.

Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

Antigua, Guatemala, 26 January 1970

Dr George Zentmyer
Citrus Experiment Station
University of California
Riverside California

Dear George:

When you were here a short time ago (how I wish I could have had a whole day with you!) you asked me to send up a few samples of the "corky" skin on the Nabal avocado. Here they are and if you know anything corkier, I wish you would tell me about it.

I believe you told me that you could not find, on the specimens you took with you some months ago, anything which seemed to come within your field of action. Be that as it may, if we cant do something about this miserable problem, it is going to handicap Nabal in this neck of the woods. It has been gaining ground here, in spite of its alternate bearing habit. As Oppenheimer told me a few years ago, in Israel Nabal is one of the leading avocados; not all trees have their "off year" at the same time, and if you take the average yield per tree over a period of ten years you get a fine yield per tree per year, even if all trees have their off year at the same time. It is true here that Nabal is capable of bearing fine crops; that is why I named the variety Nabal, which means "abundant, plenty" after an Indian woman told me "Nabal li okh tin keh" which means, being translated, "it beuzns lots of avocados".

Best regards always

Faithfully yours

Wilson Popenoe

Antigua, Guatemala 3 January 1971

[John Elliot Coit]
Dear Doctor Coit:

Many thanks for the interesting article on kakis. I still keep on trying to push them here but it is painstakingly slow work. As far as I know, propagation has never been done by any nurseryman in Guatemala, nor elsewhere in Central America. It takes the trees such a long time to come into bearing! And I have just heard that the German up at Coban, 4000 feet (a good elevation I think) who had a bearing orchard of about 50 trees, probably Hachiya, has grubbed them out. Last year I ate half a dozen fruits from his orchard and they were great. Incidentally, the young Guatemalan horticulturist who brought them to me said, I am going to tell you something. It takes these fruit an awfully long time to soften up for eating. You set the fruits, stem end up, in a cup, and pour a teaspoonful of vinegar in around the calyx, and they ripen almost overnight. I did, and I kept true fruits as a check. The fruits with the vinegar at the basal end ripening in two days, and were fine eating; the ones left to ripen normally took a week or more. Have you ever tried this?

My old Fuerte tree has been in full bloom for a month, but as yet I don't see ~~any~~ any fruit set. Night temperatures in the upper 40s, day: in the middle 70s. No rain at this time of year.

I am trying to push ahead with the avocado work, a bit, and wish I knew more about Bacon and Zutane, the two recommended varieties in California for marginal (cold) areas. We don't have either of these varieties here and we could do with something for 8000 to 8500 feet where the Guatemalans won't quite take the cold - some years. I hate to bother you, but what do you know of the background of these two varieties. I have seen Bacon once, at Sta Barbara, and got the impression

that it is a Guatemalan x Mexican hybrid, maybe a seedling of Fuerte. What do you know about it? And Zutano: I seem to have read that it is a pure Mex, and that it is not. Again, what do you think? I am wondering if it is something on the order of Puebla. I was going thru my Mexican notes of 1918 the other day and found what I had written about Puebla, of which I saw the parent tree. I wasn't too sure about its nature. In 1958 I found it growing at Valencia, Spain, one of several trees Knowles had sent over - almost against the will of these conservative Spaniards. (The folks at the Ministerio, that same year, 1958, refused my offer to send them a nice batch of grafted trees; said they didn't care for avocados) But when we were on the Costa del Sol last August, along with Zwi Schachar, we went to the new experiment station near Malaga, which is run by a smart young German, and they have an avocado project. In fact, as I think I have told you, they have sent their new avocado man (I say new, but I don't mean they ever had one before; they didn't) to California for a year. I hope you will meet him and preach the law and the gospel. While much of the best land on the Costa del Sol has gone into winter resort apartment houses and tourist traps (in ten years since I had been there huge cities have grown out of small towns we knew in 1958) there is still a lot of agricultural land available around Malaga, but I don't like the soil too well. If they ever get Phytophthora in it they will be spurles versenkt, unless Quin-X from San Diego does what they say it will do. I have just received their propaganda and I am consumed with curiosity. Is there anything to it, or is it a case like we had with Panama disease. We could kill it by using formalin in the soil but we couldn't quite afford to dose 10,000 acres with formalin.

All good wishes for 1971.

Faithfully yours

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DEPARTMENT OF PLANT PATHOLOGY

RIVERSIDE, CALIFORNIA 92502

February 16, 1971

Dr. Wilson Popenoe
Casa del Oidor
Antigua, Guatemala, C. A.

Dear Wilson:

I was very interested in your recent letter from Tegucigalpa, with all of the information on avocados. I would certainly like to get some seeds and budwood of that "wild avocado of San Isidro," from either Costa Rica or Honduras. Do you think that Antonio Molina could get us some?

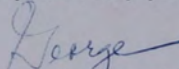
I have seen the avocado collection at Alajuela; it does look very good. They do have Phytophthora cinnamomi in Costa Rica; I made some isolations quite a few years ago from dying trees over near Orotina -- there was quite a lot of root rot in that area.

I was very sorry to miss you in Antigua, and also in Costa Rica; we were in Antigua mostly on coffee berry disease January 22-25, and I then went to San Jose and Turrialba for a couple of days on cacao Phytophthora, avocados and coffee. In the market in Cartago I found an interesting variation of Persea schiedeana (Yas); this was an almost oval green fruit instead of the long-necked "Yas" I have seen in that area before. It had the typical greyish-brown flesh, and was mostly seed; I collected some seeds.

We will be expanding our collections for root rot resistance in Mexico and Central America in the next year, with some special funds from the California avocado growers, via the Society. I would appreciate very much any further suggestions you may have on locations to collect other species that we do not have, and also any vigorous, old avocado trees that might possibly have some resistance. Thanks indeed for any comments.

All best wishes,

Very sincerely yours,


George A. Zentmyer
Chairman and Professor

AB.

GAZ:ab

Antigua, Guatemala 22 Feb 1971

Dr George Zentmyer
University of California
Riverside.

Dear George:

Your letter of the 16th has just come. I havent heard from Antonio Molina, as to whether or not ~~he~~^{he} was able to get over toward La Libertad in Comayagua and collect herbarium material of the hard-shelled Guatemalan with Mexican anise. I believe, if we dont let any grass grow under our feet, we can get seeds of this strange avocado for you, probably about September or October. I will check up on my notes and see when it matures fruit. I wish I could get herbarium material of this interesting thing; to me it will be just another wild form of Persea americana, but if it gets into the hands of a dye-in-the-wool splitter, he will make a species out of it. But I dont know on what sound basis. He cant use the anise odor because the Mexicans have it. I havent seen any other difference in the numerous wild trees I have examined, but of course I havent seen flowers. Maybe they dont have any pubescence; then they would have to go along with Trapp, which Blake named P. leiogyne but it didnt stick. And if the flowers are quite fuzzy, it would throw this tree into the Mexican group, where its anise odor would be a natural; but how are you going to get away from those hard-shelled fruits. Of course the herbarium botanists cant do much with avocado fruits; they dont keep well on the herbarium specimens. Lucille Kopp says the Mexican avocados are black. Of course she has us, because color of a fruit doesnt matter. Except when the bors here in Guatemala try to convince you that a Winter Banana apple is a Red Astrakhan.

Probably my last heretical production will be this paper on the distribution of P. americana which is now engaging my attention, as those fellows would say who talk about "exploring the possibilities" and searching for "the key men." I am sure I wrote you that the lads over in Australia got me started on this, by asking about introgression of fringe species in the make-up of horticultural avocados. It seems to me you mentioned, in one of the Yearbooks, that you thought you had seen forms of P. americana which had got messed up with P. schiedeana, and others which seemed to have some blood of - was it P. liebmanni? I have always been looking for avocados with schiedeana blood. If there are any, they should be in the Orizaba-Cordoba region of Mexico. Lord knows there have been plenty of opportunities there; way back in 1918 I "explored the possibilities" but didn't find anything which looked convincing. What got me down, in Orizaba, was the immense number of trees which bore small aguacates of the West Indian race. I couldn't quite figure this out, and can't yet. They looked to me like West Indians, alright. I have a lot of observations made in Orizaba; I believe I made notes on 100 trees, part of them I listed as Mexican, part of them West Indian; and there were lots of chininis (schideanas). I didn't see any hard-shelled guatemaltecos in that region. Remember this was in 1918. Or maybe it was 1917. And I didn't know anything about Persea floccosa at that time. I don't know much yet. It seems to me Art Schroeder and maybe you were with him, have studied the aguacates of the Orizaba region more than Williams and I did. But I wonder, and I ask, if there still isn't a possibility of something interesting for you in that region? So many little aguacatillos, true species. Do you think you have worked through all the material which might be available, in the hope of finding a compatible rootstock resistant to Phytophthora?

Many thanks for the information regarding root-rot in Costa Rica. Extremely interesting. I wish I could have seen you on this last trip,

to get the last word on root-rot in several tropical American countries. Now that I work free, I am asked for a good many "consultations" and I want to know what to say. As for your oval green Yas in Costa Rica, I have seen plenty of these, though in Mexico, Guatemala and Honduras they are usually bottle-necked, more or less. Incidentally, I am getting the impression that most of the wild Perseas of the avocado group, and some others, are round or egg-shaped or round. Isnt that true of the most primitive forms of the Mexican race? Isnt it true of the wild avocados of Guatemala and Honduras, the ancestors of the Guatemalan race? Isnt it true of Paul Allen's wild avocados of Costa Rica, which I believe ^{are} the ancestors of the West Indian race? I wonder if it isnt true that the wild avocados in general stayed round or egg-shaped until the Indians began to look at them as good eating, that they stuck their necks out?

If God grants me grace (as my beloved friend Archie Shamel used to say) I am hoping that I can get around a bit during this coming summer and autumn. For example, two years ago I saw some queer avocados over in the Jalapa region in Guatemala. I brought some seeds home and planted them but no one wanted to grow them on and I didnt have room. Why didnt I send them to you? I might go again this coming summer. And I think it might be worth while for us to "cambiar impresiones" a very useful, non-committal Spanish term. You say you have lined up a few pesetas and are coming down again. I wont ask for any of the pesetas but I am going to begin watching for interesting trees. I hope I can still do something. It makes me furious when I realize that I cant climb the Volcan de Agua, to make it the sixth time. It aint my heart, its just my legs.

Ever faithfully yours,

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DEPARTMENT OF PLANT PATHOLOGY

RIVERSIDE, CALIFORNIA 92502

March 1, 1971

Dr. Wilson Popenoe
Casa del Oidor
Antigua, Guatemala, C.A.

Dear Wilson:

Thank you very much for your interesting letter of February 22. I was very glad to have your comments on various avocados, other species of *Persea*, etc. and to know that you are still interested in that marvellous fruit, the avocado. I hope that we will be able to get some of the various types that you mention for our rootstock tests.

Could you please let me know when you expect to be away from Antigua in the next couple of months; I hope to get down again in connection with our accelerated collecting program, and want to be sure to come when you will be there. Please let me know your schedule.

Thanks very much. All best wishes,

Very sincerely yours,

A handwritten signature in blue ink, appearing to read "George".

George A. Zentmyer
Chairman and Professor

GAZ:jl

P.S. I don't recall having published anything on possible hybrids between the avocado and *P. schiedeana* or *P. liebmanni* though maybe my memory is remiss--I will check this. Some of the people I have been working with in Mexico think that there are hybrids between avocado and *P. cinerascens* (formerly called *P. liebmanni*) in the Michoacan area; I haven't seen these yet.

I agree that the Orizaba area should be an interesting one to check further, and certainly don't think that we have exhausted the possibilities for resistance.

I have seen small-fruited native *P. americana* in several parts of Mexico--notably in the mountains south of Monterrey where they are growing with oaks and pines.

Antigua, Guatemala, 8 March 1971

Dr George Zentmyer
University of California
Riverside.

Dear George:

Ament your letter of 1 March, I fully intend to be in Guatemala until late May or early June, when I shall probably make a semi-annual higira to Zamorano to sample the mangos. Here in Guatemala, I take a day or two off now and then, to find out why we have to use a sandwich graft on our pears or call the Winter Banana apple Red Astrakhan, or something of that sort, but if I know you are coming I can always be waiting for you in Antigua, and the more I think about it the more I feel that perhaps I might be able to help you this year on the Great Safari, as my fellow members of the Explorers Club would term it. Every time they get 250 miles from Hollywood it is a Safari.

I am still worrying about this idea of "introgression" in our avocados. You remember I asked you about it, and in this recent letter you said you weren't quite sure about one or two points. In the 1966 Yearbook, p. 79, J. Galindo y G.A. Zentmyer state: "A possible genetical infiltration into the cultivated avocado is suspected, respectively, from P. liebmanni in Michoacan and P. schiedrana in Tabasco."

From what you say in this last letter, I feel pretty sure you had not personally seen either of these "infiltrations", but the statement starts us thinking about such matters, and a lot of similar ones. I believe I wrote Art Schroeger about a Mexican avocado (i.e., race) which didn't have the anise odor. And we have talked a lot about that Guatemalan avocado (i.e. again) which has lots of anise in it.

I have just been looking over my Mexican notes of 1918-1919. (when you come down we will work these over a bit). I cant get over the number of trees in Orizaba dooryards which I classified as West Indian, but which had very small fruits and not very thick skins. But they didnt have any anise odor. if my nose was in good shape. I just wonder if some of these queer little fellows could have given rise to the account of Mexican avocados with no anise odor? When I was in Orizaba in June no avocados were ripe.

The resistance of Duke to root rot, not complete of course, makes we wonder if we have given enough attention of seedlings of this race in tropical America. You will recall that when you and I were in Querétaro some years ago I was amazed to see how many of the fine old avocados I had know in 1918 were gone. And another case: When I first went to Venezuela about 1936 there were hundreds of avocado seedlings, West Indian race, around the Lake. When we went back some ten years ago to that meeting of the Tropical Region, those trees were 'ratically all gone, with the except of a group near Valencia on a tiny sandy flood plain. Of course all those trees were West Indians and perhaps would not be of any value in California. I am not clear about this matter; probably you are.

I wonder if you have ever had a good look at avocados down on the atlantic side of Guatemala? I recall planting trees from Lancetilla on the banana farms of that region - heavy wet clays in some cases - and I wonder what has happened to them. I think it might be worth while to run down there.

No need to do ore guessing and speculating at the moment. I am not ghe one to do it anyway. But I do hope we can get together here be-
der you start this summer's campaign.

Faithfully yours,

Yearbook of the California Avocado Society 1966, J. Galindo and
George Zentmyer, "Cooperative Project attempting to solve the
Avocado Root Problem, pp. 79 et seq:

"A possible genetic infiltration into the cultivated avocado is
suspected, respectively, from *P. liebmanni* in Michoacan and
P. schiedeana in Tabasco".

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RIVERSIDE, CALIFORNIA 92502

November 27, 1972

Dr. Wilson Popenoe
Culle de la Nobleza No. 2
Casa del Oidor
Antigua, Guatemala
C.A.

Dear Wilson:

It was good to have your letter of November 5 with your interesting comments on the avocado situation in Mexico and South America, and on the problems at Rancho California in Spain.

I was very interested in Luis Sarasola's comments on what he thinks may be Verticillium and Phytophthora in Spain. There is really not much new on Verticillium. We see only occasional cases of this disease here in California, and I have seen it only rarely in other countries. As I am sure you know, diseased trees quite often recover; one new thing in this regard is that the fairly new systemic chemical Benlate (benomyl), a DuPont product, is quite effective against Verticillium, and if they have many cases of the diseases it might pay to aid recovery by injecting the trees with Benlate or applying it to the soil. Certainly they should be careful about using other susceptible crops as interplants in young avocado groves, or in the previous cropping sequence--things such as tomato, pepper, olive, eggplant, etc.

As to Phytophthora I would be glad to culture some roots if Luis Sarasola could send me a few small feeder roots from trees that he suspects of having Phytophthora root rot. He should wash the soil from the roots and put them in a small plastic bag and just send to me in an airmail envelope. I would like to get over there sometime and see what they are doing with avocados in Spain; I have not visited Spain yet.

We had Francisco Montes, a young pathologist from Spain, with us for 8 or 9 months; I think that he is the one that you mentioned in your letter. He was interested mostly in citrus viruses, and got along very well here.

Gene Schieber told me that he has had some good talks with you regarding our avocado collecting project. I hope that he will stay on this for awhile, as he is getting some interesting collections. I want to come down to Guatemala and other parts of Central America sometime this winter, and would like very much to see you. Do you have special plans for being away very much in December, January or February?

I have done some collecting myself in Columbia, Venezuela, Ecuador, Peru, etc. As I recall, it was based on your comments that I found some trees that looked like native avocados near Fusugasuga in Columbia. Also there are some different looking West Indian types in the Cauca Valley, though I do not know whether any of these are native types in the hills around there. There are undoubtedly other types in Columbia that we should collect, such as in the Santa Marta area etc. I also collected some aguacatillos from Columbia and Venezuela--Persea caerulea which is one of our highly resistant, non-graft-compatible types from the Pittier National Forest in Venezuela, and a similar small-fruited one from Columbia that was then classified as P. chrysophylla, but which I think is now put in P. caerulea.

I visited the Queretaro area several years ago again, and had one of our collectors visit there last year. There are very few avocados left in that area (La Cañada etc.), and we have not had any success in finding possibly resistant survivors. As for Atlixco, they definitely have Phytophthora, and have had for quite a few years now. You are correct in your recollection of Phytophthora at Xahuentla; Gilly has had a lot of trouble there and has lost many trees. There doesn't seem to be nearly as much problem in the Rodilles grove; I have suspected that the soil was better there. There are several other groves in the Atlixco area that I understand are having problems too, though I have only been to Gilly and Rodilles groves.

I am sure that you are right in thinking that we should do more exploring in Mexico, and I hope to be able to arrange this too. We have done a little in the Orizaba, Huatusco etc. area, but have only just touched the surface. In that regard you will be interested to know that I have some Beilschmedia anay seeds from the Jalapa area of Mexico, and it looks as though Beilschmedia does have some resistance to Phytophthora. We are checking this further and will let you know--Gene Schuler has collected Beilschmedia from the location you gave me near Tzatzamp.
With all best wishes to you and Mrs. Popenoe.

Very sincerely yours,

George

George A. Zentmyer
Chairman and Professor

GAZ:cw

*How about Anay X Mexican or Guatemalan?
Schudiana X americana
Then from Hornstead
Avocados for Guardian*

Antigua, Guatemala 1 February 1973

Dear Hugh: [Popovoc]

George Zentmyer spent a day with us last week and I took advantage of the opportunity to talk with him regarding the project you have for sending a man from Gainesville (or Homestead, I believe) to tropical America to study Phytophthora cinnamomi on avocados. George is in favor of the project, and says he has already had some correspondence with the man - I believe it is a Dr. Holland, isn't it?

In view of the fact that most of the work done so far has been based on the needs of California, where rootstocks of the West Indian race are not used, and in view of the fact that this man is going to be interested especially in Florida, where only West Indian rootstocks are used, George agrees with me fully that the thing to do is to work around the Caribbean. George has done a little work on West Indian rootstocks from the Pacific coast of Central America but not much.

We do not seem to have much information regarding the presence of Phytophthora on the Caribbean coast or in the Islands - at least I don't. The one big case I have in mind is what happened around Lake Valencia in Venezuela in my time, where avocados practically disappeared within a period of 20 years except on a small sandy vega near the town of Valencia. There was a good paper on this subject published by a pathologist with an Italian name (I think he is an Italian) who was working at the agricultural college in Maracay when I was last down there some 10 years ago.

I think it might be well to start at that point, then work northward. We might be able to get some information in advance

in advance from Jamaica, Puerto Rico and perhaps Trinidad also. I think these would all be interesting regions.

I don't think George has done anything on the Caribbean coast of Central America; he and I have often mentioned that we should have taken a look at avocados in the banana regions of Costa Rica, Honduras and Guatemala.

I believe the program George would have in mind as a starter would be to go to a region like the one in Venezuela, where the disease has hit hard, and see if any trees can be found which are on heavy, wet soil and have escaped. This seems to be the obvious approach, doesn't it?

Siempre su mismo

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RIVERSIDE, CALIFORNIA 92502

July 12, 1973

Dr. Wilson Popenoe
Calle de la Nobleza No. 2
Casa del Oidor
Antigna, Guatemala

Dear Wilson:

I enjoyed very much seeing you again last month and appreciate very much the discussions, transportation, and fine hospitality while I was there. Please thank Mrs. Popenoe again too for the wonderful meals.

I did not recover any Phytophthora cinnamomi in the cultures from roots and bark of trunks from the avocado trees in the variety planting at Apocentros. From the "cankers" another peculiar fungus, which may be a different species of Phytophthora is growing out. I will let you know when I know more about this.

With all best wishes and many thanks again,

Very Sincerely Yours,

A handwritten signature in cursive script that reads "George".

George A. Zentmyer
Professor of Plant Pathology

GAZ:pb

P.S. I am going to Argentina later this week to look over some avocado root rot problems, and may be able to stop for a day in Guatemala enroute back north.

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RIVERSIDE, CALIFORNIA 92502

August 9, 1973

Dr. Wilson Popenoe
Calle de la Mobleza 2
Antigua, Guatemala

Dear Wilson:

It was a pleasure to see you again last month in Antigua, and to discuss avocados and make the visit to San Juan Obispo.

You will recall the bark samples that I took from young (2-year-old?) trees in the variety planting at Apocentros Nursery in June. These had cankers on the lower trunk and rootstock that I thought might be caused by Phytophthora cinnamomi. Cultures that I made from these, though, showed a different fungus, and this now appears to be Phytophthora citricola, another species of Phytophthora that we have found recently on avocado in California. This species can cause some trouble in the form of cankers but is not very pathogenic to avocado roots. We had an article about it in the Avocado Yearbook that just came out this spring.

As far as I know this is the first isolation of P. citricola from Central America. It would be a good idea for them to pull up and burn the trees that were showing this canker in the young planting—there were 3 or 4 of them, ^{AS I RECALL} Then, to reduce further spread, they should fumigate the young tree sites with some fumigant such as D-D, or Telone, or Vapam, or methyl bromide, as is suggested in our Root Rot Circular 511. I would think that fumigating an area about 5 ~~feet~~ ^{feet} out from the young tree site would be adequate (an area 10 ft. in diameter).

With all best wishes.

Very sincerely yours,

A handwritten signature in blue ink that reads "George".

George A. Zentmyer
Professor

GAZ:al

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RIVERSIDE, CALIFORNIA 92502

August 13, 1973

Dr. Wilson Popenoe
Calle de la Nobleza 2,
Antigua, Guatemala

Dear Wilson:

I neglected to give you more information in my recent letter on the young trees at Apocentros Nursery from which I isolated *Phytophthora citricola*. One of the trees was a Panchoy, in the first row toward the right as you approach the variety planting from the nursery. The other bark samples were from Panchoy and Siquinale trees, which were several rows farther into the variety planting, and which were dying back.

Best regards.

Very sincerely yours,

G. A. Zentsmeyer
Professor

GAZ:jl
cc: Dr. Schieber

DR. EUGENIO SCHIEBER

PLANT PATHOLOGIST

P. O. BOX 226

ANTIGUA, GUATEMALA C. A.

August 31, 1973

Dr. George A. Zentmyer
Professor
Department of Plant Pathology
University of California
Riverside, California
U.S.A.

Dear George:

This morning I visited the nursery at Los Aposentos and saw the disease affecting the avocado collection there.

The disease is present in the following varieties:

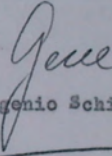
Rinconada
Obregón
Panchoy
Siquinalá
Guatenca 2
Siquinalá Chocolá

I took with me a friend from the Ministry of Agriculture who works in Plant Protection and he is going to provide the Vapan and Nemagón and follow up your instructions.

It seems that the disease is spreading, since it is affecting now more avocado varieties as I listed above.

Best regards,

Very sincerely yours,


Eugenio Schieber

cc. Dr. Wilson Popenoe ✓

DR. EUGENIO SCHIEBER

PLANT PATHOLOGIST
P. O. BOX 226

ANTIGUA, GUATEMALA C. A.

September 6, 1973

Dr. George A. Zentmyer
Professor
Department of Plant Pathology
University of California
Riverside, California
U.S.A.

Dear George:

I want to inform you that today a friend of the Ministry of Agriculture made the application of chemicals in the Aposentos avocado nursery.

Three chemicals are being tested against the disease. These are:

1. Ditraxex at the rate of 25 cc per gal. water.
2. Vapan at the rate of 50 cc per gal. water.
3. Nemagón at the rate of 4 cc per gal. water.

Five plants were treated with Ditraxex, another five with Vapan and four plants of the different varieties affected with Nemagón.

Ditraxex is a Nematicide-Fungicide, that I have used in coffee nurseries in the Dominican Republic. It is a German product (Shering).

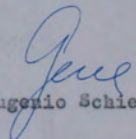
The treatment with these three chemicals was made around the plant $2 \times 2 \text{ m} = 4 \text{ M}^2$. The chemicals were incorporated at 10-20 cm. into the soil.

By the treatment of 14 trees that are starting to show symptoms, you can see how severe and how fast the disease has spread.

I will be visiting the nursery sometimes to see the effect of the different treatments and keep you and Dr. Popence informed.

Best regards.

Very sincerely yours,


Eugenio Schieber

cc. Dr. Popence ✓

Antigua, Guatemala 7 April 1974

Dr Louis O. Williams,
Field Museum of Natural History
Chicago.

Dear Louis:

In your letter of 25 March you suggest that there be two papers, one by me on the origin and history of the avocados, and another by you on the taxonomy, both to be published, probably simultaneously, in "Economic Botany". I think the suggestion is good. I have already covered much of the origin and history in the Yearbooks of the California Avocado Society, but it is scattered over a period of 30 years or more and we have quite a bit of recent information which I have not published in the Yearbooks. I believe the time is ripe to summarise the whole business. I have been waiting for years to publish a paper of the kind I now have in mind, , hoping that we could clear up a bit the distribution of wild avocados in South America, but we will not get this in my time, and as a matter of fact we lack very little. As you mention in your letter, nobody living today has seen so many avocados in so many places as I have, and again as you say, the field experience of yourself and myself ought to be put down in black and white before either of us kicks the bucket. In my case, I am already making passes at the bucket.

I have just gone through all of the Yearbooks of the California Avocado Society. There is a tremendous amount of material in those volumes. And some elsewhere - many years ago they got out a bibliography of the avocado in California, and it was mentioned that I was responsible for 75 titles, more, at that time, than anybody else had chalked up. Many of these titles, of course, were popular in character. Not scientific contributions by any means.

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SANTA BARBARA • SANTA CRUZ

COLLEGE OF BIOLOGICAL AND
AGRICULTURAL SCIENCES
CITRUS RESEARCH CENTER AND
AGRICULTURAL EXPERIMENT STATION
DEPARTMENT OF PLANT PATHOLOGY

RIVERSIDE, CALIFORNIA 92502

April 29, 1974

Dr. Wilson Popenoe
Calle de la Nobleza 2
Antigua, Guatemala

Dear Wison:

I was very interested in your two good letters of April 6th, regarding Mexican seedlings in general and also Rancho California.

I received a report from Gene on his visit to Ecuador, and also quite a variety of Mexican seeds from that area which I will be interested to test for Phytophthora resistance. That is a beautiful and interesting area; I was there on a brief visit in 1958--Ibarra and the Guailabamba Valley mainly, with an even briefer look at the Chota Valley.

Duke is one of the main varieties showing moderate resistance to Phytophthora, though in the last year or so we have had indications of some resistance also in a Mexican rootstock (type unknown) that we have recovered from an old Fuerte tree surviving in a root rot area in Vista--the Huntalas grove. Also Mexican seedlings from seeds that Gene and I collected from a Matul Oj tree on the slopes of Acate-nango have shown some interesting resistance, at least in the first collection, though seedlings from the second collection that we made last summer did not show up as well. One or two other P. americana types have shown some resistance, though it has not been very high.

One Guatemalan collection, from some of our early collections in Guatemala--a moderately small Guatemalan type fruit from a tree on the road to Coban--(my number G22) has looked fairly good, but not quite as good as Duke cuttings.

I think that there is more hope in the Mexican types. I agree too that the seeds from which Duke developed must have come from Mexico; when I visited Oroville about 15 years ago to find out more about the origin of Duke this seemed to be the general opinion too, though without any positive data.

We should probably take another look in the Queretaro region, though the last time I was there several years ago there wasn't much left in the way of avocados. There have not been very many areas in Mexico with many seedlings dying out such as in the Queretaro and Tres Rios areas, as far as I know. If you know of others I would be glad to have the information. There has been considerable root rot of course in the Atlixco area, much of it on grafted trees; the Rodilles grove never had much trouble with root rot. I was at Gilly's old Hacienda Xahuentla last fall and there are one or two surviving Fuertes in the old root rot areas from which it would be worth trying to recover the rootstocks. Dr. Galindo at Chapingo has a man working on root rot now; he was with me on that visit and they will try to recover the rootstocks there at Gilly's.

April 29, 1974

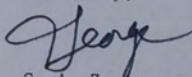
I have never made a big planting of *drymifolia* seedlings in root rot land; I had hoped that our greenhouse screening tests would show up any that were worth further testing. I have put several hundred seedlings into some soil tests at Riverside and in a plot at Fallbrook. From some of this work came my selection of Duke 6 and Duke 7 which we are propagating by cuttings for these large-scale field tests now. Maybe we should try a largescale field planting with several thousand Duke or other Mexican seeds. A few growers have planted 4 or 5 Duke seeds in one planting site and have selected one that grew best of these, with some success.

I will check with Bob Bergh or Bob Platt to see if it is possible to send some Reed scion wood to Luis Sarasola. I am pretty sure that the patent is still in effect on Reed, so he might have to pay extra for that wood. I would be glad to take care of the payment, if material can be obtained; then you could pay me when convenient, or when I am in Guatemala.

I hope to get to Guatemala sometime later this spring or early summer, to go over the avocado project with Gene and to see you. I certainly appreciate all of your suggestions and ideas in this regard.

All best wishes to you and Mrs. Popenoe,

Sincerely,



G. A. Zentmyer
Professor of Plant Pathology

GAZ:sh

Wilson: For your information I am enclosing some copies of my reports to the Avocado Research Advisory Committee for the years 1972 & 1974. This gives results of some of our resistance plots in the field.

1972

NOT FOR PUBLICATION

AVOCADO DISEASES

Most of the research on this project has emphasized control of the major problem affecting the avocado here as well as in many other countries, Phytophthora root rot. Information is also included on sun blotch and several other minor problems.

Phytophthora Root Rot

Several aspects of the research on root rot were carried out during the year, with emphasis on resistant rootstocks, fungicides, and studies of the causal fungus.

Resistant Rootstocks.--The search for a highly resistant, compatible rootstock continued, in California as well as in Latin America, with considerable expansion of this program because of increased funds made available from the California avocado industry. Many additional locations for collecting other species of Persea were obtained from herbarium collections at several Botanical Gardens and from discussions with Wilson Popenoe in Guatemala. Since the additional funds for the resistant rootstock program became available in the spring of 1971 we have obtained the following collections:

Persea americana (avocado)

- 27 collections from Mexico
- 36 collections from Guatemala
- 1 collection from El Salvador
- 6 collections from Costa Rica
- 1 collection from Honduras, sent by Dr. A. Molina -- "Aguacate de anis" (a collection we have been trying to get for several years)

Persea americana v. gigantea

- 1 collection (60 seeds) sent from Honduras by Dr. A. Molina

Persea americana v. nubigena

- 2 collections from Guatemala

Persea schiedeana ("chinini", "coyo")

- 3 collections from Mexico
- 2 collections from Guatemala
- 1 collection from El Salvador

Persea steyermarkii (?)

- 1 collection from Guatemala

Persea vesticulata ("canok")

- 1 collection from Guatemala

Persea species unknown-- 2 collections from Mexico, 1 from Guatemala

Beilschmedia anay ("Anay") -- closely related to Persea

1 collection from Mexico; 1 from Guatemala

Ocotea sp. (avocado relative)

1 collection from Costa Rica by Dr. W. H. Waite

Additional locations have been obtained for a number of other collections; these will be made as soon as possible. Collections during this past year were made by several collaborators in Central America and by members of our own staff. Dr. Schieber in Guatemala is now working part-time on the project.

Several trees have been found that are growing well in root rot areas in California; attempts are being made to recover the rootstocks of these. Rootstock sprouts were obtained from one such vigorous, possibly resistant, tree in Vista, but the tree has sun blotch.

Approximately 1000 seedlings and cuttings were tested for resistance in the tanks in our greenhouse. Moderate resistance was found in some of the cuttings tested (Duke 6, Duke 7, G-22, and Grace); slight to moderate resistance in some seedlings. 161 survivors of the tank test were transplanted into infested soil for further screening. One Guatemalan collection (G24-71) had approximately 30 per cent seedlings with 70 per cent or less root rot in the tank test, and thus is promising for further tests.

Results of a test with cuttings illustrate relative resistance:

Variety	Per cent of plants with		
	30% or less rotted roots	31-60% rotted roots	61-100% rotted roots
Topa Topa	0	3	97
J- (Mexican collection)	5	35	60
Grace	5	62	33
Duke 7	0	80	20
Duke 6	20	70	10
G-22	40	50	10

Several of the cuttings surviving the tank test in 1970 and transplanted into soil infested with Phytophthora cinnamomi are still making good growth and have shown no foliage symptoms of root rot; these are cuttings of Duke 7, Duke 6, and G-22.

Two experiments were run during the year to determine if the resistance to Phytophthora stem canker corresponds to resistance to root rot; if so, this would be a simpler and quicker test, as it involves wounding the stem, inoculating the stem with cultures of P. cinnamomi, and measuring the extent of the canker after from 2 to 8 weeks.

Following are the results of the first test:

Variety	Number of Plants	Mean Area of Canker (cm ²) in 8 weeks
Duke 7	9	1.8**
Duke 6	10	2.1 *
Duke Parent	10	2.2
Duke S	10	2.2
G-22	10	2.6
Scott	10	3.2
Topa Topa	10	3.2

2 inoculations made on each plant

All plants are cuttings, except Topa Topa

**Difference significant from Topa Topa at 1% level

* Difference significant from Topa Topa at 5% level

In the second canker inoculation test Duke seedlings showed significantly more resistance than Topa Topa seedlings, at the 5 per cent level, with cankers on Duke 10 seedlings averaging 1.88 cm in area, and on 10 Topa Topa seedlings averaging 2.99 cm. A complicating factor appeared in the stem inoculation test, however, as cankers on resistant species of Persea (P. borbonia, P. pallida and P. Donnell-Smithii) were nearly as large as those on Topa Topa. Possibly a different mechanism may be responsible for the resistance of roots of these species to Phytophthora, or resistance may primarily be to entry of the pathogen into the tissue -- with the stem inoculation test a wound is made and the fungus is placed directly in the wound. Resistance in Duke may be of a different type than resistance in the wild Persea species.

The excellent cooperation continued with E. F. Frolich at UCLA in regard to propagating cuttings and growing trees for the field plots on resistance. Additional field plots were established in Los Angeles, San Diego, Santa Barbara and Ventura counties, with the help of Farm Advisors Len Francis, Don Gustafson, George Goodall, and B. W. Lee, and the active cooperation of many interested growers. The total number of trees planted in 25 field plots in 1971 was 1300, including the following varieties: Duke 6, Duke 7, Duke Parent, Duke S, G22, Grace, Scott, Topa Topa, Fuerte on Duke 6, Hass on Duke 6, Zutano on Duke 6, Fuerte on Duke Parent, Hass on Duke 6, Hass on Duke Parent, and Hass on G22.

In plots established prior to 1971, results have been variable but in general trees on Duke cuttings or seedlings have shown more resistance than those on Topa Topa or other Mexican seedlings. There have been some problems with initial establishment of trees on some plots. Typical examples of results to date follow:

San Diego County Plot:

<u>Variety</u>	<u>Per cent of trees with root rot, after 2 years</u>
Duke 6 cuttings	11
Fuerte on Duke 6	40
Fuerte on Topa Topa	66

Ventura County Plot (15 trees of each type)

<u>Rootstock</u>	<u>% of trees with root rot after 1 year</u>
Topa Topa	66
Duke 6	0
Duke 7	0
G22	20
Scott	7
Duke S	14

One of the largest plots established in 1971, in Carpinteria, involves 180 trees. In the first 6 months, the Duke 7, G22, and Duke 6 cuttings are making excellent growth there, while many of the Topa Topa seedlings are showing root rot symptoms. Current status of that plot follows:

Carpinteria Plot (20 trees of each type)

<u>Rootstock</u>	<u>% of trees with root rot after 1 yr</u>	<u>Rootstock</u>	<u>% of trees with root rot after 1 yr</u>
Topa Topa	30	Duke 6	5
Scott	25	Fuerte on Duke 6	5
Duke S	25	Duke 7	0
G22	15	Hass on Duke 6	0
Duke Parent	5		

Soil Fungicides.--The search was continued for effective soil chemicals that could be applied to trees in early stages of root rot to protect them from further disease development, or applied to healthy trees with the object of protecting them from root rot. Many chemical companies were contacted and a few new materials were obtained; there is not much interest or progress on new materials of this type by the chemical companies. Tests for fungitoxicity to the avocado root rot fungus were run in the laboratory, and in our standard greenhouse test for root rot control on seedlings in soil infested with the root rot fungus.

1974

AVOCADO DISEASES

Again, the major emphasis in this phase of avocado research was on Phytophthora root rot, with some studies also on the virus disease, sun blotch and a few other problems.

Phytophthora Root Rot

Research on this serious disease was carried out under five major categories this year, with the assistance of substantial support from avocado marketing order funds: Resistant Rootstocks, Biological and Chemical Control, Studies of the Fungus, Irrigation and Aeration, and Compatibility.

I. Resistant Rootstocks--G. A. Zentmyer and N. T. Keen

1) The search for substantial resistance in graft-compatible material continued, with our collector, Dr. E. Schieber making 173 collections during the year, with some additional collections from other cooperators. Collections were made in Mexico, Guatemala, El Salvador, Nicaragua and Costa Rica, as follows:

Persea americana (avocado), and P. americana drymifolia

- 42 collections from Mexico,
- 97 collections from Guatemala
- 20 collections from El Salvador
- 1 collection from Nicaragua

Persea schiedeana

- 3 collections from Guatemala
- 1 collection from Costa Rica

P. rigens (?)

- 3 collections from Nicaragua
(the identity of this collection is doubtful; this may be a new species of Persea)

P. standleyi (?)

- 1 collection from Guatemala

P. steyermarkii

- 1 collection from Guatemala

P. pallida (?)

- 1 collection from Costa Rica

P. vesticula (?)

- 1 collection from Guatemala
- 1 collection from Costa Rica

Persea (species unknown)

- 1 collection from Mexico

Ocotea sp.

- 1 collection from Costa Rica

Phoebe sp.

- 1 collection from Costa Rica

2) The search continued for possibly resistant trees in areas in California where root rot has been present for many years. Several additional trees were found, and attempts will be made to recover the rootstocks. Initial tests from cuttings rooted from one such tree in Vista indicate that this tree does not have appreciable resistance to root rot.

3) 1387 seedlings and cuttings were tested for resistance in the nutrient solution tank test and in soil tests in the greenhouse at Riverside. Those showing appreciable resistance were: several Persea americana drymifolia (Mexican) types from Guatemala, P. americana from El Salvador, Duke 6 cuttings, Huntalas cuttings, and G-6 cuttings (from selected seedling). 194 survivors of tank tests were transplanted into infested soil for further screening for root rot resistance. Several surviving seedlings from previous tests are growing well in a secondary soil screening test in the lathhouse.

4) E. F. Frolich at U.C.L.A. rooted many more cuttings in our cooperative program of developing trees for field tests for resistance to root rot. In 1973, additional field plots were established, or additional trees were planted in previously established plots, in Riverside, San Diego, Santa Barbara, and Ventura counties, with the cooperation of Farm Advisors Len Francis, Don Gustafson, George Goodall, and B. W. Lee and many cooperating growers.

During 1973, 1204 trees were planted in 27 field plots in the four counties. These included the following varieties: Duke 6 cuttings; Bacon, Fuerte, Hass, and Zutano on Duke 6 cuttings; Duke 7 cuttings; Bacon, Fuerte, Hass, and Zutano on Duke 7 cuttings; G-22 cuttings; Fuerte, Hass, and Zutano on G22 cuttings; Grace cuttings, Huntalas cuttings, and two Mexican cuttings.

5) Compatibility tests--some of the P. americana drymifolia collections from Guatemala (as G-6) are compatible with avocado. Compatibility of P. steyermarkii and the new species from Nicaragua is not yet known.

6) Appreciable resistance is evident in several of our field plots established during the past three years. Results on a plot involving 105 trees in Santa Paula are as follows:

Rootstock	Percent of trees with root rot after 3 years
Topa Topa	67
G-22	13
Scott	7
Duke 6	0
Duke 7	0
Duke parent	0
Duke S	0

In a field plot in Fallbrook, involving 108 trees, similar good growth in an old root rot area is being obtained with the following rootstocks, after four years: Duke 6 cuttings (9% with root rot), and Fuerte on Duke 6 (29% with root rot). 73% of the Fuerte on Topa Topa trees in this plot are showing root rot symptoms.

7) Chemical Basis for Resistance--A. Zaki, N. T. Keen, J. J. Sims and G. A. Zentmyer

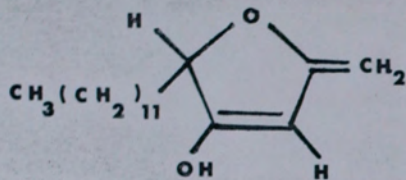
Research was continued for the isolation and chemical characterization of a preformed antifungal substance from Persea borbonia. The crude substance was isolated from pulverized, air-dried twigs by column chromatography. Further purification was obtained by acetylation of the crude substance and separation of the major component by thin layer chromatography.

The purified substance had the empirical formula $C_{19}H_{32}O_3$ (M.W. 308). Spectral data (u.v., ir, and nmr) provided sufficient information to propose a chemical formula for this antifungal substance which was given the trivial name "borbonyl acetate". (see attached sheet)

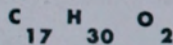
Various lines of evidence suggested that the natural substance was present largely as the free alcohol "borbonol" with minor quantities of "borbonyl acetate". Both forms of this substance, the free alcohol and the acetylated derivative, appeared to be equally active against Phytophthora cinnamomi and Cladosporium cucumerinum in the bioassay.

Borbonol was present largely in the stele with minor quantities in the stripped bark of the twigs of Persea borbonia. It was positively detected in the roots of P. borbonia and in the twigs of P. caerulea, P. pachypoda, and P. skutchii but not in the roots of P. americana var. Topa Topa. Other antifungal substances were detected in the root extracts of P. americana var. Topa Topa but none of them corresponded to borbonol or borbonyl acetate.

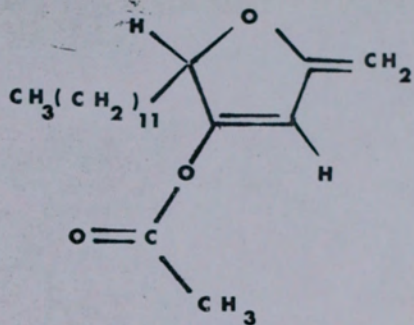
Research is being continued on the confirmation of the chemical structure of borbonol and on its possible role in the resistance of avocado to Phytophthora cinnamomi.



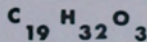
BORBONOL



M.W. 266



BORBONYL ACETATE



M.W. 308

II. Biological and Chemical Control

1) Soil Fungicides--G. A. Zentmyer

The search was continued for effective soil fungicides that could be applied to trees in early stages of root rot to protect them from further disease development, or could be applied to healthy trees to protect them from root rot. Tests were run this year using lower dosages of fungicides applied more frequently, for possible use in drip irrigation systems also.

During the year 13 chemicals were evaluated for control of P. cinnamomi in laboratory and greenhouse tests. In the frequent, low dosage application Terrazole gave the most consistent control, at from 5 to 15 ppm in solution. Other fungicides in order of effectiveness in this type of test were: CHE 1843, Dexon, Nabam, and Difolatan.

Laboratory tests showed that Terrazole is a better fungicide than Dexon, and does not merely act fungistatically by preventing P. cinnamomi from growing and sporulating. Infected roots and agar disks containing mycelium of the fungus were incubated in solutions of Terrazole. The root rot fungus was killed by exposure to a 20 ppm solution of Terrazole for 24 hours, and growth was reduced at concentrations of 2.5, 5, and 10 ppm.

Terrazole has retarded progress of root rot in field trials and is being tested further. In a plot in Fallbrook consisting of 24 trees, Terrazole and Dexon have reduced disease development for three years. Two other plots, with trees receiving granular Terrazole along with a new plot recently initiated with trees receiving liquid Terrazole (emulsifiable concentrate) through a drip irrigation system, are located in Santa Barbara county. The first samples of fruit from these Terrazole plots were analyzed for residues last year, and "no detectable residue" was found. Terrazole is not yet registered for use on avocado, however, and thus field treatments are still on an experimental basis.

2) Systemics--G. A. Zentmyer

A new systemic fungicide, Dowco 269 (2-chloro-6-methoxy-4-(trichloromethyl)pyridine), provided in a different formulation (M3858), reduced root rot of avocado seedlings when applied as a drench in the greenhouse. The percentage of healthy roots at the termination of this experiment was: no treatment = 2, 100 ppm 3858 = 18, 200 ppm 3858 = 48. The systemic has not been very effective in control of stem cankers when applied to the soil. No other systemic chemicals are presently available for use on Phytophthora.

3) Combination Treatments, Nutrition, and other Soil Treatments--G. A. Zentmyer and T. W. Embleton

Field trials of cutting back trees in plots in Fallbrook, with and without additional fertilization and fungicide treatment, have given variable results. In a few cases, cutting back trees with no other treatment has given at least temporary stimulation of new growth.

In greenhouse trials, maintaining nitrogen in the ammoniacal form with N-SERVE significantly increased growth of avocado seedlings in soil infested with P. cinnamomi, and retarded root rot development for the first two months of the experiment. With no further attempt to maintain nitrogen in the ammonia form, root rot increased in the last two months of the experiment until all treatments had high percentages of rotted roots. This phase is being studied further to determine possible use in the field.

Application of high levels of calcium and potassium, in the form of several salts, to soil infested with P. cinnamomi reduced root rot on avocado and Persea indica seedlings in the greenhouse. Further tests are being run to see if this is an effect on the fungus, on host nutrition, or on other microorganisms in the rhizosphere, and to determine possible use for root rot control in the field.

In the test of drip vs. sprinkler irrigation in beds of infested soil in the lathhouse, root rot has developed more rapidly under the sprinkler irrigation. Eight of 12 seedlings are still healthy in the soil infested with P. cinnamomi under the drip system, while only 3 of 12 seedlings are healthy in the sprinkler system. The disease has moved into an area of healthy soil, from the infested area, more rapidly also under the sprinkler system.

The first evidence was found of the presence of the endotrophic mycorrhizal fungus, Endogone, in avocado soils and in avocado roots. In citrus this type of fungus apparently contributes to normal growth and nutrition. Its role in relation to avocado is not yet known, but is being studied.

4) Fumigants--D. E. Munnecke

In a previous report details were given as to methods and techniques used to determine the dosage response of P. cinnamomi to methyl bromide. This work has been finished and the completed work will be published in Phytopathology in 1974 in a paper by DEM, James L. Bricker & M. J. Kolbezen entitled, "Dosage response of Phytophthora cinnamomi to methyl bromide"; an abstract of the work is as follows:

Dosage responses of P. cinnamomi to methyl bromide (MB) were determined in 48 experiments by fumigating the fungus in a free-flowing system at concn ranging from 4,000 - 38,700 ppm (vol) for exposures of 1-46 hours. The various LD90 values were linearly correlated by plotting the log concn (ppm) vs log time (h). In this way concentration x time products (CT) for all LD90 values, within limits, were obtained. The slopes of the CT regression lines obtained for P. cinnamomi growing on agar, in living roots, or existing as chlamydospores in soil were almost identical, indicating that the response of P. cinnamomi to MB was uniform, regardless of the type of test material used. Analysis of the three CT curves indicated that chlamydospores were the most sensitive to MB.

A few of the significant aspects of these studies follow:

a) The results provided a basis whereby the action of toxicants, such as methyl bromide, may be studied more accurately.

b) The curves for the CT values may be used to estimate the efficacy of field and laboratory fumigations, even in the absence of P. cinnamomi.

c) When combined with future research, they should be usable to predict whether field fumigations of avocado orchards would be adequate to control P. cinnamomi.

d) They indicate that laboratory cultures of the fungus may be used in lieu of infested roots as test materials for toxicant assay studies. (Laboratory cultures are easier to obtain in large numbers and are generally more uniform to use as experimental materials).

In other experiments, not reported previously, an effort is being made to determine whether certain soils from a commercial avocado nursery have properties that are inhibitory to pathogenic fungi such as P. cinnamomi, or Rhizoctonia solani. To date the research has been concerned with developing reliable methods for such studies and there are no results to report as yet.

5) The Survival and Activity of Phytophthora cinnamomi in soil - H. S. Bhalla, P. H. Tsao and G. A. Zentmyer

Emphasis has been placed on the effects of soil amendments on the survival of P. cinnamomi in a natural soil. In a series of tests, various amendments high in organic nitrogen (e.g., chicken manure, cow manure, alfalfa meal, and a commercially manufactured product of high protein content, CMPHPC) have been tested at 2% level (w/w) for their effects on the recovery of P. cinnamomi from natural avocado soil highly infested with chlamydozoospores grown in culture. Most effective in reducing the population of the fungus in soil were the CMPHPC and chicken manure amendments. The alfalfa meal and cow manure amendments were not as effective. The two materials tested at lower concentrations, chicken manure at 1% and 0.5% and CMPHPC at 1% were also not as effective. A sudden increase in the soil pH of amended soil at 7-10 days after amendment has been noted and the increased pH level of soil, especially in CMPHPC amended soil, was maintained for a considerable length of time.

In order to obtain a much needed standard method of producing sporangia to be used *in vitro* studies in relation to soil amendments, some progress has been made in defining the requirements for the production of sporangia by P. cinnamomi under axenic conditions. Results from several tests have shown that fragments of young mycelium placed on sterile nylon mesh squares and allowed to grow in the presence of very small quantities of diluted nutrient medium for approximately 24 hours produced, in general, relatively few and variable numbers of sporangia upon repeated washings of the mycelium with salt solution and incubation under cool fluorescent light. Thus far, it has been found that the source of the medium used for growing the fungus prior to washing with salt solution, and the composition of the salt solution are important factors affecting the production of sporangia by P. cinnamomi under these conditions.

In an attempt to maximize the formation in culture media of chlamydospores to be used in soil infestation and in vitro studies, several tests were made to study the effects of using the salt solutions (as substitutes for water) as postgrowth incubation media and of starving the fungus during the postgrowth incubation period on formation of chlamydospores by P. cinnamomi. The latter was accomplished by careful replacement of the nutrient medium, used for growing the fungus, by water following repeated washings of the fungus mycelium. Neither the use of salt solutions as postgrowth incubation media nor the starvation of the fungus during the postgrowth incubation period have resulted in consistently increased formation of chlamydospores.

6) Suppressive Soils--K. F. Baker and C. L. Schoulties

Research continued on the microbial stimulation of zoosporangial production by Phytophthora cinnamomi. Efforts were successful in late 1973 to isolate a single bacterium from the soil which could stimulate the fungus to sporulate. Much of the information in this report was, however, obtained from studies of zoosporangial stimulation by a general microflora or with the stimulant extracted from a general microflora.

In addition to the microbial stimulant being readily extractable by acetone, the stimulant was extractable with water. Extraction of stimulant was complete with one acetone extraction, whereas; five or more extractions were required with water. Lysis of cells by sonication and/or lysozyme-EDTA did not increase the efficiency of water extraction. These results suggest that the stimulant in an aqueous soil extract is (1) external to the cell either bound to or part of the cell wall, (2) adsorbed to soil particulate matter, or (3) of limited solubility in water. Recent preliminary data with the single bacterium indicate that the compound may be part of the bacterial cell wall.

Attempts were made to purify, concentrate and characterize the stimulant from the soil microflora. The stimulant was firmly adsorbed to silica gel when non-polar solvents were used as eluants. Only when polar solvents were used was the stimulant eluted. Since "like" solvents elute "like" solutes, results indicated that the stimulant was polar in nature. Elution profiles indicated a rather homogenous compound. Gel chromatography with Bio-Gel P₂ (100-1800 Daltons) and Sephadex G75 (2000 to 75,000) suggested a single high molecular weight compound. The stimulant eluted in the void volume of the smaller sieved gel and near the void volume of the larger sieved gel.

One of the main obstacles to in vitro experimentation with P. cinnamomi is its variability. Efforts were directed at minimizing variation. Sporulation was greatly affected by the following: light, culture age, method of culture initiation and source of distilled water. The fungus was found to sporulate two to three times as much in light as in darkness. Twelve to twenty-four hour cultures sporulated without the addition of stimulant to the ionic solution of Chen and Zentmyer. Cultures older than twenty-four hours showed sparse zoosporangial formation in the ionic solution; however, those solutions which contained the extracted stimulant supported abundant sporulation. Cultures that were initiated by single zoospores exhibited much greater uniformity in zoospore numbers and zoosporangial distribution than did cultures that were initiated by the conventional agar plug method.

On two separate occasions, the distilled water source from the Plant Pathology Department at the University of California, Berkeley, was contaminated with material(s) that stimulated the fungus to sporulate. Presumably, this material is volatile and thus differs chemically from the stimulant produced by bacteria which was non-volatile under distillation. This problem of contaminated water has been avoided by using another source of distilled water. By standardizing light conditions, utilizing zoospore-initiated cultures of comparable age (i.e., diameter), and using triple-distilled water, much of the variation encountered in in vitro experimentation with P. cinnamomi has been reduced.

The aforementioned bacterium which can stimulate P. cinnamomi is in the process of identification. The ability to produce the compound is an unstable character. An isolate that had been repeatedly subcultured lost the ability to produce the stimulant. Stock cultures, however, of the same isolate still are able to produce the stimulant.

At Riverside, cooperative studies conducted with Miss Patricia Broadbent, New South Wales Department of Agriculture plant pathologist who was here for three months, gave indication of some suppressive action in one Fallbrook soil. This soil gave considerable lysis of mycelium of P. cinnamomi, but did not have significant effect in inhibiting production of sporangia. This is being investigated further by G. A. Zentmyer and K. F. Baker.

III. Studies of the Fungus, *Phytophthora cinnamomi*--J. V. Leary and G. A. Zentmyer

1) Genetics and Variation

A) Mutagenesis: Attempts were continued to obtain stable mutants of P. cinnamomi utilizing a variety of mutagens. New procedures for mutagenesis and selection were devised. We have still been unable to isolate stable nutritional mutants but several mutants which are blocked in morphogenesis have been obtained. Also, mutants for mating-type specificity were isolated.

B) Morphogenesis: These studies were concentrated in three areas:

1) Oospore Dormancy: Efforts were concentrated on characterizing the subribosomal ribonucleoprotein particles² in dormant oospores. They have been shown to be smaller than the ribosome subunits, have a lower buoyant density than ribosomes and/or ribosome subunits, and to contain typical ribosomal RNA. Efforts are underway to analyze the ribosomal proteins contained in these particles, the role of these particles in maintaining dormancy, and any changes in the particles upon germination are also under investigation.

Studies on the ultrastructure of dormant oospores were begun. Preliminary electron micrographs indicate that the contents of the dormant oospore are contained in numerous vacuoles and that no cytoplasmic organelles such as mitochondria, ribosomes, etc. can be recognized.

2) RNA Synthesis: The effects of antibiotics on RNA synthesis in growing mycelium and germinating zoospores is under investigation. Preliminary data indicate that chloramphenicol sensitivity is correlated with the rapid synthesis of mitochondrial ribosomes and ribonucleic acid in a specific, short-lived time period. Other compounds which inhibit RNA synthesis in mitochondria, such as ethidium bromide, have an effect similar to that of chloramphenicol. These data support the above conclusion.

Another aspect of the research on RNA synthesis is the recent finding that nucleic acid base-analogues, such as azaguanine and azadenine kill Phytophthora spp. This apparently occurs by interference with nucleic acid synthesis. Mutants resistant to these compounds are being sought. These will permit more precise analysis of the mechanisms of RNA synthesis and ways of interfering with these processes.

3) Protein Synthesis: Using the in vitro protein synthesis system developed last year, we have continued our studies on protein synthesis in dormant oospores, zoospores, germinating zoospores, and growing mycelia. Some results obtained would indicate:

a) Cytoplasmic ribosomal protein synthesis is not inhibited by chloramphenicol.

b) The oospore is incapable of synthesizing proteins no matter how old the spores are. These data indicate dormancy is imposed quite early in the life of the oospore.

c) The dormant oospore is lacking other components of the protein synthesis system such as enzymes and the energy producing system.

4) A large number of antibiotics and metabolic poisons inhibit protein synthesis by growing mycelia and germinating zoospores.

C. Variation in Pathogenicity: Seven tests were made during the year, to compare the pathogenicity of 9 different isolates of P. cinnamomi (from avocado, camellia, macadamia, pine, cinnamon, eucalyptus, and heather) on several hosts--avocado, pine, camellia, eucalyptus, and Persea indica. The original type culture from cinnamon trees was the most consistently pathogenic culture, on all hosts. Isolates from macadamia and camellia (North Carolina) are generally very low in pathogenicity to all plants tested, and an isolate from azalea tends to be low in pathogenicity. On eucalyptus stems, all 9 isolates tested showed some pathogenicity; the most pathogenic were the isolates from avocado, camellia (California), cinnamon, and pine. Inoculations were made on avocado roots, avocado stems, Persea indica stems, eucalyptus stems, and camellia stems.

Studies on pollen transmission of the disease

2) Other Fungus Studies

Preliminary tests have provided information on temperature sensitivity of P. cinnamomi. Most isolates of the fungus do not grow or make very slight growth at 33° C (91° F), but can survive at that temperature for at least 8 days. Three isolates grew well at 33° C. Mycelium is killed by exposure to 36° C (97° F) for 24 hours, or by exposure to 45° C for 10 minutes, or 50° C for 5 minutes. Further thermal death point data are being obtained, including the response of chlamydo-spores. No cultures tested grew at 6° C (43° F), all cultures made very slight growth at 9° C (48° F).

A new method of isolation of P. cinnamomi from soil, using disks cut from avocado leaves shows some promise, and could be used at any time of year, in contrast to the fruit trap method which depends on availability of suitable green fruit.

53 additional cultures of P. cinnamomi were obtained during the year, to be used in genetic, pathogenicity, and taxonomic studies. These cultures were from Mexico, Australia, Taiwan, Argentina, El Salvador, Hawaii, Dominican Republic, U.S.S.R., New Zealand, and California. They were isolated from the following plants: Agathis, avocado, azalea, Ceanothus, heather, Macadamia, Myrsine, pineapple, pine, Senecio, Styphelia, Ohia (Metrosideros), Tawa, and Rhododendron.

In studies of the distribution of P. cinnamomi in soils, the fungus was recovered most commonly and abundantly in samples taken near the surface (0-6" and 6-12"), but was also isolated from the 30-36" depth.

Other Avocado Diseases

Sunblotch--J. M. Wallace and R. J. Drake

Investigation of avocado sunblotch disease during 1973 dealt largely with indexing of budwood and seed parent trees for which applications have been made to enter them as candidates for registration. The role of the University in this activity was to help collect the necessary seed and inoculation material, in cooperation with the California Nursery and Seed Service of the State Department of Agriculture, and to maintain records of the check seedlings inoculated from known infected sources. Many of the test seedlings were inoculated and maintained at the Brokaw Nursery in Saticoy and some test of some candidate trees were conducted in University facilities at Riverside.

In 1973 and including January 1974, index tests were completed on 28 candidate parent trees at Saticoy and Riverside, all of which were negative for sunblotch. On the other hand, many of the inoculated check seedlings developed strong symptoms within 18 months. There were no symptoms after the two years on the seedlings inoculated from the parent trees entered for registration.

Index tests on 22 new candidate trees are in progress currently.

Avocado Sunblotch Virus--P. R. Desjardins

Studies on pollen transmission of the virus were continued. These

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DEPARTMENT OF PLANT PATHOLOGY

RIVERSIDE, CALIFORNIA 92502

October 7, 1974

Dr. Wilson Popenoe
La Casa del Oidor
Antigua, Guatemala

Dear Wilson:

I appreciated very much your suggestions in your good letter of July 21st, even though I am very late in replying. I am sorry that it wasn't possible to get Gene Schieber down to Columbia and Ecuador this summer--funds just didn't permit it and it wasn't possible to get such a trip organized. The collections that he did make in Ecuador earlier in the year look interesting; we are just getting some tests for resistance on seedlings grown from seed that Gene collected in various parts of Ecuador.

As I believe I mentioned, I did collect Paul Allen's wild avocado of Golfo Dulce, near Golfito, several years ago; this is an interesting primitive, oval fruit that looked to me like a primitive West Indian type. The seedlings had no resistance to Phytophthora. I am hoping that the Florida group may be able to get into places such as the mountains near Santa Marta in Columbia.

You have a good point in suggesting spending some more time in the Atlitxco area; I was there just briefly about a year ago, but didn't get much time to look around. Maybe I can work this in before long.

Have you heard anything from your friend Luis Sarasola in Spain? I sent the Reed budwood to him this summer, and hope that it arrived in good condition.

All best wishes to you and Mrs. Popenoe.

Sincerely,

A handwritten signature in cursive script, appearing to read "George", which is the first name of G. A. Zentmyer.

G. A. Zentmyer
Professor of Plant Pathology

GAZ:sh

October 9, 1974

Dr. Wilson Popenoe
Casa del Oidor
Antigua, Guatemala

Dear Dr. Popenoe:

These days have been hectic ones for me. Even with a 60 hour week I have not gotten to all of the things that I ought to do. And I have to cut down on the long hours for I am getting a bit tired.

The Rubiaceae has been rechecked and the manuscript turned in, some 350 plus pages and more than 60 plates. It has gone to press and it is hoped that I will finish reading the proofs before I go away next month. I have my doubts about this for that is a lot of proofs and we are going to get out of Chicago by the middle of next month. This part of the flora is due to come off the press in January 1975 so the editor says. We will have quite a large part of the Compositae manuscript ready to go to the editor before I leave in about a month.

Avocados:

How far south P. americana var. americana may be native I do not know. I would not object to Costa Rica or even to Panama. I quite agree with you that the native types should be round-fruited with round seeds. Man certainly has had a very prominent role in the distribution of economically useful plants and avocados certainly would have attracted early man's attention. I do not think that man's migration down the Americas was a "one-shot" affair but rather that it took place over a very long period of time. Macneish has come up recently with a much increased "estimate" of the time man has been in Peru, 23,000 years. If this is a good guess, and I suspect that it can be backed up with carbon 14 evidence, then we have a whole new lot of things to think about. I don't suppose that avocados go back so far but anyway we can not exclude the possibility that they were there a long time ago. I wrote to C. E. Smith, who is a botanical anthropologist, and suggested that he think about what might or could have happened with man and plants across the isthmus during the Wisconsin glaciation. The temperature must have been very much cooler along most of the tropics where man was migrating. There is also the fact that the sea was some 300 feet lower than it is today and the vegetation on the isthmus probably of a different kind than it is today. The coast of Peru might have had quite a different climate due to ice in the Andes, and I wonder if the lower level of the sea might have had an effect on the Humboldt current and its course. I do not recall having read anything about that.

Armando Dugand died several years ago. There is no one in Colombia that I know who really knows much about the Colombian flora nor has much interest in the origin of cultivated plants there. I think that Patiño is gone also.

José Cuatrecasas is at the Smithsonian and active. He is most accomodating and I am sure that he would provide you with any information that he can. We have the original set of Cuatrecasas' collections and there is only one here. It bears the data: Dept. del Valle, Cordillera Occidental; hoya del río Calima: El Cairo, entre Darién y Mediacanóa, 1.650-1.7750 m. alt. 6 , 7 enero 1943, No. 13898.

There are two collections by Lawrance (a character incidentally who eventually was non grata in Colombia), that could well have been wild. "Forest edge, El Umbo region, alt. 3000 ft. Tree 80-100 ft. high, 4-5 ft. in diam. Flowers pale green with yellow center. Region of Mt. Chapon, extreme western part of Dept. Boyaca, north-west of Bogora. ^{NOV. 5} ~~NOV. 21~~, 1932. number 562. The other does not give a specific locality but is on the same Mt. Chapon label,- Thick high forest, alt 3800 ft. Tree 100-150 ft. tall, flowers greenish yellow. July 21, 1932. No. 344. Both collections in flower.

There are a number of Peruvian collections, none saying that the plant was in cultivation but none giving data that would indicate for sure that the trees were in the native forest. Only one collection has a fruit and that is the pyriform West Indian type.

I have my notes on the systematics of avocados based on what is in Zamorano. I think it would be possible to get it in shape in a very short time if you get the other part done. Is Zentmyer working with you on the origin and history?

END of Avocados.

Tonio Molina is here and working hard, beginning at about 7 in the morning, even before I get here. I suspect that he will stay until at least the middle of November. We have a new field car on order for him. It should be delivered about the end of this month. They are staying with a "cousin" over in the northwest part of the city. Tina looks bored to death with little to do.

We are going to leave Chicago about the middle of November and go down to Arkansas where we plan to stay until May when we will be back here. I enclose an address sticker that you can put up somewhere in case you need it.

We are due to spend 4 or 5 months in Central America, - Nov. 1975 to about end of March 1976. Farther ahead than this I do not even think anymore.

Sincerely,

Robin

October 9, 1974

Dr. R. E. Schultes
Botanical Museum
Oxford Street
Cambridge, Mass 02138

Dear Dick:

While I was in Central America last winter Wilson Popenoe talked about the possibility of preparing two complimentary papers on the avocados. Dr. Popenoe to do the longer paper on the "Origin and History of the edible Perseas". My part is to prepare a review of the species of the subgenus Persea which contains all the avocado and avocado-like species.

Popenoe, as you know, has been working with the cultivated avocados for a life-time. I suppose I have seen more wild avocados in the field (all but one of them) than anyone else and more than anyone is likely to see again. With our background we should be able to prepare a reasonably definitive/^{work}on these important cultivated plants.

Would you be interested in having a look at it for Economic Botany?

In case you would like to have a first look I would tell you that there are two new Perseas in the lot. Should they be published before hand or left for E. B.?

Sincerely,

Louis O. Williams

CC: Popenoe

Antigua, Guatemala 20 October 1974

Dr George A. Zentmyer
University of California
Riverside.

Dear George:

Many thanks for your letter of the 7th. I have been working at long range on the situation in Colombia, as regards wild avocados, and have a very interesting letter from Victor Manuel Patiño of Cali who says he has seen lots of a type which he calls "endemic" in the Atrato and Chocó regions; he says they are of the West Indian group, pyriform fruits greenish yellow in color, but the problem is, are they really indigenous or escapes from cultivation. Same story as at Santa Marta.

Luis Sarasola wrote some time ago that the budwood of Reed reached him in fine condition, and many of the buds were breaking into growth at the time he wrote. He is delighted to have Reed because he has read such good reports of it in the Yearbooks. He thanks you very much for sending the budwood and so do I. I have just received a report from New Zealand that scions of Collinred which I sent over there, packed dry in plastic bags, arrived in beautiful condition after ten days on the road - or rather, in the air. It is pleasant to find that shipping budwood in plastic bags such long distances can still give such good results. Too bad we didn't have airplanes and plastic bags 50 years ago when I was trying so hard to get budwood alive to Washington.

Best regards always.

Faithfully yours,

Wilson Popenoe

Antigua, Guatemala 20 October 1974

Dr. José Cuatrecasas
Smithsonian Institution
Washington D C

Dear Doctor Cuatrecasas:

You have done so much field work in Colombia I wonder if you can give us some help in connection with the distribution of Persea americana as an indigenous tree. To explain what we are after - Dr George Zentmyer of the University of California at Riverside and myself - we are trying to determine the origin and distribution of the indigenous forms of the horticultural groups of the avocado. The Mexican race, which was originally described by Chamisso and Schlechtendahl as Persea drymifolia, which name we are going to use because we are convinced it is a good species, indigenous from northern Mexico to Guatemala thought very rare in this country; the Guatemalan race, which Lucille Kopp calls P. americana var. nubigena, which occurs as a wild tree from Oaxaca and ^{Chiapas} ~~Oaxaca~~ clear down to Nicaragua, very abundant in some regions as in parts of Oaxaca and Guatemala and Honduras; and the West Indian race, which Kopp calls P. americana var. americana, regarding the distribution of which, in its wild or primitive form, we are still not quite clear. Paul Allen found what he believed to be the wild form of this group in the Golfito region of Costa Rica, and published a good illustration in his excellent book, "The Rain Forests of Golfo Dulce".

As you know, the first record we have of the avocado is in Fernando de Enciso's "Suma de Geografia", published in 1919 at Sevilla. Enciso saw this fruit in a small valley at the foot of the Sierra Nevada de Santa Marta in Colombia.

Several of us have tried to find this wild or primitive form of the West Indian avocado, s-called (as you know, P. americana was almost certainly not in the West Indies until taken there by the Spaniards) but all we have so far is the wild tree of which Paul Allen saw numerous specimens, almost certainly indigenous, in the Golfo Dulce region. We are trying to determine whether or not some botanist has seen it in Colombia or farther south. I am strongly inclined to believe it should be in Colombia, in the rain forest region at low elevations, perhaps a few hundred to a thousand meters or so.

Now, we shall be extremely grateful to you if you will tell us if you have ever come across, in your collecting trips, a wild avocado such as Paul Allen found. I myself have hunted for it on the lower slopes of the Sierra Nevada de Santa Marta, not far from Santa Marta itself, but found only escapes, of what I felt were escapes, because there was such a variation in form, size and color of the fruits. I have a letter from Victor Manuel Patiño who tells me he has seen the same thing in the Atrato and Chocó regions. Lots of "wild avocados" but there is always the doubt that they are escapes from cultivation.

The archeologists have shown that avocados were cultivated in the valleys of the Peruvia coast in pre-Columbian times, as far south as Nazca. And Huayna Capac is believed to have taken it from southern Ecuador to the warm valleys near Cuzo about 1475. But what was the distribution of P. americana var. americana before it was brought into cultivation by man? Can you give us any help in solving this problem.

Faithfully yours,

Wilson Popenoe

[Route 6, Pointe Clear
Rogers, Arkansas 72756]

FIELD MUSEUM
OF NATURAL HISTORY

October 22, 1974

Dear Dr. Popenoe:

On Sunday the first snow flurry of the year fell on me while I was out riding my bike. That is the signal,—in two or three weeks we are going to Arkansas and if it doesn't get too cold we will stay there all winter. If it gets too cold then the coast of Vera Cruz is only three days away by car.

I had a letter from Dick Schultes yesterday about the two works on Persea. I copy his short letter:

We would like to consider the avocado work for Economic Botany. It belongs rightfully there.

With the great backlog in manuscripts, however, we are striving to keep very long manuscripts from being submitted. I suggest that you and Popenoe submit your papers as separate contributions and we can try to publish them in the same number. I see no reason why new species should not be published in Economic Botany. In fact, I think this is a very appropriate place for them just so long as the novelties are in an economic genus.

I shall try to get material together and get the systematic part of the manuscript typed up and ready to submit before we leave here, not too great a problem since the basic part is done. — I have some photographs that I took years ago of that small avocado that we got above Tetla. Griswald, a couple of Indians and you are in one of them. These can be used.

I am using Field Museum and EAB for some of these recent papers and I guess that I would do that with the one on systematics of Persea since much of the field work was done there.

Antonio Molina is here and will leave about the middle of November. Life-Time books wanted me to do a consulting job in Guatemala but I do not want to go down and suggested Antonio who will be passing through at about the right time. He will get a fee for a week's work the likes of which he never heard of before.

Can you get me a note back before November 10, please.

Regards,

Louis

Just bought Antonio a new field vehicle.

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November 11, 1974

Dear Dr. Popenoe and Dr. Zentmyer:

I have been working away on a synopsis of the avocados in subgenus *Persea*, as you know. I thought that I had a pretty good understanding of the systematics of these plants and the way that the scientific names might apply to the 4 commonly cultivated avocados. - the "Guatemalans", the "Mexicans," the "West Indians," and then the whole mass of things exemplified by "fuerte" and a great number of similar horticultural varieties.

I had assumed that the name *Persea americana* var. *americana* could be applied to all the "West Indians," all of the derived "Guatemalan" types and to all of the presumed hybrid types that make up the "fuerte" group. The name *P. americana* var. *drymifolia* could be applied to the occasionally cultivated little "Mexican." *Persea nubigena* could be applied to all the wildlings with small round fruits that grow down the mountains from Mexico to Costa Rica.

Miller's description of *Persea americana* and his account of it leaves not the least doubt that he was describing the pyriform thin shelled West Indian avocado. Linnaeus description under *Laurus persea* is of the same thing. This is an exceedingly variable thing but I think basically we could call it *P. americana* var. *americana*.

Next is the little, usually, black Mexican. This has basically the name *P. drymifolia*. By Blake and Kopp and a host of others, including myself, this has been called *P. americana* var. *drymifolia*. I am beginning to doubt that we should do it this way. Even though we do not know this plant from the wild I am beginning to believe that that it should be given specific status. So far as I know it is relatively stable and the plants that we saw in the Orizaba Valley, thousands of them, and at Parramos and a few other places in Guatemala seem to have come true from seeds. This (or intergressants of it?) with the Guatemalans (or intergressants) could have been the source of the fuertes and all the similar kinds which are so unstable.

Next are the Guatemalans and we know small fruited primitive ones from Vera Cruz and Puebla to Costa Rica in the montane forests. This is *Persea nubigena*. I suspect that the so-called Guatemalan race is hardly more than selections of this by the Indians over a millenium or more. These are relatively stable things as one might suspect where only one species is involved. Now if we wish to distinguish these Guatemalans with a scientific name I think that this should be based upon *P. nubigena*, - *P. nubigena* var. "X" for the moment. Not put together with the West Indians under *P. americana* var. *americana*.

If we do this could we not reasonably derive the "fuertes" from *P. nubigena* (or *P. nubigena* var. "X") with perhaps *P. drymifolia* the other parent? The West Indians would be left as a species without myself, at least, suggesting a hybrid origin for them.

Doing this we would have this line-up of all the subg. Persea:

1. Persea americana. (the var. americana would disappear since I would attach no other variety to it.)
2. P. drymifolia.
3. P. nubigena var. nubigena (the wildling)
- 3a. P. nubigena var "X" (varietal name to be selected) which would be the name for the relatively stable large fruited cultivated or escaped Guatemalans.
4. Persea floccosa (a montane species related to P. nubigena).
5. P. schiedeana, which we all know, a variable species from the coast of Vera Cruz to Costa Rica, Panama and perhaps Colombia.
6. P. primatogenia, the curious avocado relative from Nicaragua.
7. P. parvifolia, collected by us in Vera Cruz 25 years ago and not seen since. It is somewhat related to P. drymifolia. I think this one and P. primatogenia have nothing to do with the origins of cultivated avocados.

This arrangement would help ^{with} a scientific name for those relatively large fruited Guatemalans sometimes found in the forest or presumed to be wild .

There is a curious thing like P. nubigena in Chiapas that I do not know what to do with. This was collected by Breedlove and I determined a flowering specimen for him a year or so ago as drymifolia ? I have just received from him the fruiting specimen and it is a small round fruited "guatemalan", fruit even smaller than ordinary nubigena. Maybe not yet mature, flesh almost none. The ^{secondary} leaf veins come out at a very narrow angle and thus more nearly parallel to the mid-vein than in any other specimens that I have seen. The leaves are narrowly elliptic, acute or shortly acuminate, somewhat ferrugineous puberulent below. The two specimens came from different localities. So far as I can remember and as far as the specimens go we have never seen one like it. — George will certainly need to see this sometime as another potential root-stalk. For his information they are Breedlove 7347 and Breedlove and Raven 13460, the last one fruiting. Localities: tree 40 feet tall, on slope with Quercus along road 2 miles SW of Huistan Center, Municipio of Huistan, Chiapas, Nov 17, 1964 (flowers); tree 50 feet, steep slope with Quercus and Pinus, 3 miles south of ~~Acat~~ Aguacatenango along road to Pinola Las Rosas, municipio of Venustiano Carranza, alt. 5600 feet, 17 October 1965 (fruit).

alt. 7,000

From these specimens and dates it would seem that it takes the fruit about a year to mature.

Dennis Breedlove is botanist at the California Academy of Sciences and I believe that he is in Chiapas at the moment. If George wishes to try to contact him perhaps someone at the Academy will know how to do it.

I will take my manuscript to Arkansas with me and finish it up there after I have comments from both of you on rearrangement of scientific names on these things.

Avocados are very difficult to name and dozens of flowering specimens of species belonging to the subgenus Eriodaphne have been called P. americana. Miss Kopp, in her revision, called a number of things belonging to P. nubigena (her P. americana var. nubigena) as P. americana var. americana. The only way to tell them sometimes is by the ecological situation from which they come, especially if there is only flowering or sterile specimens. This is why I think it might be just as well and perhaps more natural to base a classification on the fruits, and then to take what characters can be had from the inflorescence and make the most of them.

Address a reply to:

Route 6, Pointe Clear
Rogers, Ark. 72756.

If Dr. Popenoe's contribution is nearly ready and it seems essential I will come back to the Museum this fall (= winter?) and finish up mine based on comments that you may have. --

It is cold here today and the weatherman is promising a bit of snow!

Antonio Molina is leaving here on the 15,- headed for Guatemala where he has a brief consulting job that I arranged for him. He should be in Antigua in approximately two weeks and will plan to see Dr. Popenoe.

Regards to you both,

Roos

More avocados.

Persea X amigena

Persea americana X P. nubigena var. guatemalensis

This presumed hybrid swarm includes the avocados, mostly Mexican highland in origin, that are extremely variable in fruit characters but hardly at all different vegetatively from the putative parents. From the point of view of horticulturists, and in commerce, these ~~selected~~ selected horticultural varieties are the most important of the cultivated avocados. Propagation of these trees is almost entirely from buds since the desirable varieties do not come true from seed.

The fruits are mostly longer than broad, ovoid or pyriform. Varieties that produce fruits weighing about a half pound are preferred for the American market. The horticultural variety "Fuerte" is perhaps the best known of these.

WHAT ABOUT THIS?

CHICAGO ILLINOIS 60631
ZOOLOGICAL MUSEUM OF CHICAGO
CONSULATE OF GUATEMALA

Since writing the letters I thought it might be best to sit down and write a description of the cultivated Guatemalans and it occurred to me that using the name Persea nubigena var. guatemalensis would help to tie this down. Here is a copy of the preliminary write-up. I am sure that you both will have comments.

Persea nubigena var. guatemalensis L. Wms. var. nov. Habitu et textura P. nubigena L. Wms. et affinibus similis et nullo dubio his speciebus proxima, praecipue differt fructibus grandiores.

Similar in habit and texture to Persea nubigena L. Wms. and without doubt closely related to this species and perhaps derived from it. The plant is known only in cultivation or perhaps as an escape from cultivation (due to seeds being cast aside along roads and trails by men walking along and eating avocados). It differs principally in having much larger fruits with the flesh often ~~2x3~~ as much ~~as~~ as 2-3 cm. in thickness; the fruit is round or nearly so, the "shell" is durable, usually 2-3 mm. thick and with prominent stone cells, usually rough but sometimes quite smooth outside, usually green in color but sometimes almost black; the flesh is usually quite good, rich in fats, and flavorful; rare seedlings have the flesh quite prominently flavored of anise and the leaves of most trees, when crushed, are scented with anise.

This is the avocado which is known to horticulturists as the "Guatemalan type" or simply as "Guatemalans." The varietal name is chose to show this relationship.

The variety is best exemplified by perhaps hundreds of thousands of these trees growing in door yards and plantations near Antigua, Guatemala, as well as other localities in central Guatemala, and likewise but less commonly at middle elevations (\pm 1,500 meters) in other Central American countries and in Mexico.

Type: Guatemala: from a tree in the patio of Casa Popenoe, Antigua, Dept. Sac., alt. 1,600 m., Popenoe & Molina 99999, December , 1974.

When Molina comes please collect the type and have him take it to Zamorano to prepare.

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DEPARTMENT OF PLANT PATHOLOGY

RIVERSIDE, CALIFORNIA 92502

December 6, 1974

Dr. Wilson Popenoe
Culle de la Nobleza No. 2
Casa del Oidor
Antigua, Guatemala
Central America

Dear Wilson:

Enclosed is a copy of an article that I prepared for "The California Avocado Society Yearbook", concerning the Phytophthora canker on avocado trees at Los Aposentos. I hope that it is all right to add your name as an author, as both Gene and I would be glad to have you join us on this little paper.

Have you heard anything from your friends in Spain as to whether the Reed budwood that I sent arrived all right?

All best wishes for the holidays to you and Mrs. Popenoe.

Sincerely,

A handwritten signature in blue ink, appearing to read "G. A. Zentmyer".

G. A. Zentmyer
Professor of Plant
Pathology

GAZ:sh

ENCLOSURES

Phytophthora Canker of Avocado Trees in Guatemala

by George A. Zentmyer*, Eugenio Schieber**, and Wilson Popenoe***

In January 1973 we observed cankers on the trunks of several young avocado trees in the variety planting at Los Aposentos Nursery (6,000 feet above sea level), the government nursery near Chimaltenango, Guatemala. Several trees were girdled or nearly girdled by cankers from which the typical white sugar was exuding, as is commonly seen when an avocado tree is wounded or invaded by a canker organism.

Isolations showed the presence of the fungus Phytophthora citricola, which we have recently found in California as the cause of avocado trunk cankers and which can occasionally be isolated from avocado roots (2). The isolations were made by the senior author, using antibiotic media (cornmeal agar with pimarin and vancomycin).

On two other trips to Guatemala in the past eight months the planting has been revisited. The number of affected trees has gradually increased from six in January 1973 to 15 in June 1974. P. citricola has been re-isolated from cankers on several trees, and P. cinnamomi has not been found in any of the cultures.

The rootstocks used in this plot are Guatemalan criollo types with fruit that vary considerably in size and shape. Several different types of scions have been infected including Siquinala, Rinconada, Haakuu Hawaii, Zamorano 10, and Chocolá 5.

Affected trees have either been girdled and have died, or are stunted

* Plant Pathologist, University of California

** Plant Pathologist, Antigua, Guatemala

*** Director Emeritus, Escuela Agricola Panamericana; address now Antigua, Guatemala.

in growth and of poor vigor and color. In moderately advanced stages severe wilt occurs and bronzing and death of the leaves. Cankers are often sunken (Fig. 1) with whitish sugar exudation apparent when not washed off by rains during the rainy season. Cankers extend into the inner bark and to some extent into the outer wood.

If detected in a sufficiently early stage it should be possible to cut out young cankers. All discolored tissue should be removed as well as at least ^{one} ~~two~~ inches of healthy-appearing bark on the margin of the lesion. The area should then be painted with some fungicidal paste or paint, such as Bordeaux paste.

This is a new record of an avocado disease for Latin America, to be added to the list published in 1959 (1).

Literature

1. Zentmyer, G. A. 1959. Avocado diseases in Latin America. Plant Disease Reporter 43: 1229.
2. Zentmyer, G. A., L. Jefferson, C. J. Hickman. 1972-73. Another species of *Phytophthora* on avocados in California. Calif. Avoc. Society Yearbook 56: 175-179.

Fig. 1. Canker produced by P. citricola, on variety
Siquinala (Los Aposentos - Guatemala).

CENTER FOR TROPICAL AGRICULTURE
INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES
UNIVERSITY OF FLORIDA

DATE:

[Jan 1975]

MEMO TO:

FROM:

SUBJECT:

Dear Dad and Alice,

I enjoyed my brief Xmas sojourn and hope we can parlay it into a trip next summer.

Casseres decided to take the job in Chile but is still hoping that an opportunity might open with us in the future.

I check chromosome nos. on ^{Paceas} ~~Caracas~~ and the ones listed all had 24 ($X=12$)

P. americana

E. N. Amer 24

W. Indies 24

Mexico 24

P. dryinfolia 24, *P. palustris* 24

P. borbonica + 3 spp. Swamp Bay = 24

I talked to Linus Mala on the phone and he is going to gift some zutano for me as well as Brooker.

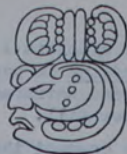
I talked with C. R. Smith and
he says that you don't need to come
up here to file your taxes - just
send him the usual information.

again, I enjoyed being with
both of you.

Much love,

Hugh [Piperov]

P.S. I came back on the plane
with Chris's niece, Pat Spahr (ex
Shelton). She would be interested in
renting or buying Alice's house. They
need to reside in Honduras to make
TAN operations legal



January 6, 1975

Dear Dr. Popenoe and Dr. Zentmyer:

I have George's letter of December 31 and since you are both involved I send the original to Antigua in case George is there before my copy gets back to California.

George apparently did not know that I had suggested companion papers on avocados to go into the journal "Economic Botany." The horticultural side to be done by P. & Z, the systematic synopsis to be done by W. Schultes has written me that the companion papers would be acceptable and that he would try to get them both into the same issue of the journal. — It was my idea, discussed with Popenoe, that the papers might be "definitive" ones on the avocado since P & Z knew more about the horticulture of these plants than anyone else, — and I assumed that I had done more with the systematics of the group than anyone else. reasonable size

The preliminary synopsis, of which I sent each of you a machine copy, was the working basis for my part. After that was typed and before I sent it off to you for comments I added two other thoughts which I hoped might provide a better scientific basis for the nomenclature of the cultivated kinds. This is what P. nubigena var. guatemalensis was intended to do for the things like the myriad "guatemalans" around Antigua and elsewhere. Persea X amigena is intended to put a usable name on the presumed hybrid swarm of things in the Mexican highlands, the fuertes and the multitude of things that were in the Rodiles grove.

If this scheme were worked out we would have essentially the following:

1. P. americana. A cultigen and type of the genus, to be limited systematically to the west indian type.

2. P. nubigena. The wildling with small fruits that we all know and so far as I know a forest species (or occasionally left when forests were cut away as seen by P & W at Cumbre del Aire in Mexico).

3. P. nubigena var. guatemalensis. I consider this to be a cultigen and a derivative of P. nubigena since I know of no other way that it could have arisen. If my memory does not fail Popenoe has one of these in the patio and I wanted Molina to collect a specimen from it for the type (voucher). Reason: association of Popenoe and his house and avocados.

Persea X amigena. I would propose this name for the hybrid swarm that includes "fuerte" and the dozens of others that we have seen or have been described as horticultural varieties. Systematically all the things (or most of them) at Rodiles, and elsewhere as Hort. Vars. would be placed under this name. I would base this hybrid name on P. americana X P. nubigena var. guatemalensis, both to be considered of cultural origin. — This it seems to me is a good systematic solution of the problem IF you agree that these things originated from crosses and intergression between west indians and guatemalans. WHAT ABOUT IT?

4. P. drymifolia. Leave this as a species, both wild (fide George) and commonly cultivated as a door yard plant. This might have been the source of of the fuerte-like things, with P. nubigena var. guatemalensis as the other parent. What about it? I think I prefer the hypothesis above.

Persea floccosa and onward in the synopsis I think is pretty straight forward with no particular problems. P. schiedeana is perhaps too variable for one species but I do not know how it could be divided satisfactorily. I would like to know more about P. steyermarkii but probably never will.

George: I do not agree with your comment that the guatemalans do not have anise. It is terrific in some of them. The character of anise scent in avocados I suspect is a "some times" thing and its presence or absence of no systematic importance, even at the level of Hort. Var. — Anise scent is scattered through the American genera of Lauraceae related to Persea.

I take it that Antonio did not stop to see Dr. Popenoe. He had a stack of trouble with the new jeep pick-up and perhaps was crowded for time.

We hope to be in Central America four or five months in 1975-1976, with perhaps March 1976 to loaf in Guatemala and Mexico.

Rua and I stopped at Monte Bello in Chiapas and drove up to the Guatemalan border on our way back last February. It is fantastic country.

Regards to you both,

Louis

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DEPARTMENT OF PLANT PATHOLOGY

RIVERSIDE, CALIFORNIA 92502

December 31, 1974

Dr. Louis Williams
Route 6, Pointe Clear
Rogers, Arkansas 72756

Dear Louis:

I am sorry to be so long in replying to your letter regarding *Persea*; this has been a busy fall quarter. The quarter and finals are finally over, and there is a brief respite before the winter quarter starts.

I will comment on some of the points that you make in your letter to Dr. Popenoe and me, and would like to discuss some of your suggestions further with Wilson Popenoe--I may get down there in January. Wilson and I and Gene Schieber, are working up a paper on the origin of the edible avocados or *Perseas*.

Your comment, regarding "*P. drymifolia*", or "*P. americana* var. *drymifolia*", that "...we do not know this plant from the wild..."--I have seen and collected fruit from what I am sure are native Mexican types (*P. drymifolia*, or whatever) from the mountains south of Monterrey--where the trees, with quite small Mexican type fruit (average about one inch in length) were growing scattered through a forest with native oak trees.

I will try to contact Dennis Breedlove regarding the strange, *P. nubigena*-like collections that you mention from Chiapas; this type might be interesting for a rootstock.

I don't understand your sheet describing *Persea nubigena* var. *guatemalensis*. If you are talking about Guatemalan types, these certainly don't have anise-scented leaves. By the "Type" in Casa Popenoe, are you referring to Wilson's Fuerte tree??

On your second addition, on hybrid types, you are correct in the statement that varieties weighing approximately one-half pound are preferred in the American market.

What are you planning to do with your synopsis of the subgenus *Persea*?

After getting your collection at Don Salazar's Hotel, Santa Maria del Ostuma, sorted out as not *Persea rigens*, in my visits to the N.Y. Botanical Garden and discussions with Caroline Allen, I would still like to get a collection of the real *P. rigens* somewhere! Do you have any suggestions?

All best wishes for the holidays and New Year.

Sincerely,

G. A. Zentmyer
Professor of Plant Pathology

CC: Dr. Wilson Popenoe ✓

Wilson - hope to see you in January - I may get to
Antigua and the 3rd. All best, G.A.Z.

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DEPARTMENT OF PLANT PATHOLOGY

RIVERSIDE, CALIFORNIA 92502

January 27, 1975

Dr. Wilson Popenoe
Culle de la Nobleza No. 2
Casa del Oidor
Antigua, Guatemala
Central America

Dear Wilson:

I certainly enjoyed seeing you again last week and having the discussions of the avocados and related edible *Perseas*. Our paper looks like it is taking shape, and should be a good contribution.

As Gene Schieber may have told you, we found some more of the rather primitive Guatemalan types in El Salvador, in the Indian village areas of Izalco, Nahyizalco, Apaneca, and will be testing some more seedlings of that type.

A Dr. Dawes from New Zealand has written me regarding his interest in *Persea schiedeana*. He wonders if it is possible to find any *P. schiedeana* trees, or at least get some seeds, of a type with good quality fruit, such as you describe in your Bulletin 734? These, in the illustration (Plate XIII) were from Tactic. Do you know of any source of good quality fruit such as that? I have never seen any *P. schiedeana* with really good quality fruit, either in Guatemala, Mexico, or Costa Rica.

Please thank Mrs. Popenoe again for the fine meal; that was really a treat. All best wishes.

Sincerely,

A handwritten signature in blue ink, appearing to read "George", which is the first name of G. A. Zentmyer.

G. A. Zentmyer
Professor of Plant Pathology

GAZ:sh

Antigua, Guatemala, 29 January 1975

Dr. Louis O. Williams,
Route 6, Pointe Clear
Rogers, Arkansas 72756

Dear Louis:

This letter refers to yours of 6 January, addressed to Dr. George Zentmyer and myself. This letter was discussed at some length a few days ago, here in Antigua, by Dr. Zentmyer, Dr. Eugenia Schieber, and myself.

In recent years Dr Zentmyer and Dr Schieber have done a lot of field work on wild and cultivated avocados, in connection with their search for rootstocks resistant to Phytophthora cinnamomi. For this reason I decided to combine my own material, most of which was brought together some years ago, with what they have accumulated and get out a joint paper on the Origin and History of the Edible-Fruited Perseas, hopefully for publication in the Journal of Economic Botany, to tie in, so to speak, with your treatment of the taxonomy. In general, we like the line-up in your letter of the 6th. In our discussions we have brought out several points which we believe will simplify things somewhat.

We believe our familiarity with avocados in the field and in cultivation, together with your own, puts the whole subject on more solid botanical grounds than is possible by working only with herbarium material. Dr. Kopp suggests this herself in her excellent monograph on the Perseas of the Western Hemisphere.

Almost the only point on which we differ with the views expressed in your letter is this: We do not feel it wise to attempt to put the hybrids between the horticultural races on a botanical basis. They constitute neither botanical varieties nor a horticultural race. They

are simply hybrids between the horticultural races, and commonly only the race of one parent is known.

I believe we are agreed that the present project is concerned exclusively with the origin and history of the horticultural races of avocado, but to make the treatment complete we are going to have to mention a few species which are not involved in the origin of the three horticultural races, because they produce edible fruits and sometimes get confused with the avocados, even by competent botanists. What do you think of treating the subject in the following manner? You have come very close to this in your letter.

1. PERSEA AMERICANA Miller. Parent of the West Indian race. We have good reason to believe the wild avocado Paul Allen discovered in Costa Rica is the ancestor of our West Indian race of avocados. The latter is not a botanical variety of P. americana, it is P. americana. The West Indian race has nothing to do with the Guatemalan race, which is derived from your Persea nubigena, a valid species, not a variety of P. americana. We have every reason to believe that the avocados seen by Fernandez de Enciso and later by Gonzalez de Oviedo (I mean Benzalo Fernandez de Oviedo, excuse me) on "tierra firme" and which later were carried by the Spaniards to the West Indies were of the horticultural West Indian race.

2. PERSEA NUBIGENA L.O. ms., which includes your P. gigantea (we would like to keep the nubigena name because it suggests the environment of the indigenous tree, while there are plenty of americanas and drymi-folias which are giants). Undoubtedly the ancestor of the Guatemalan race of avocados. Abundant in cloud forest regions from Oaxaca and Chiapas to Nicaragua. It forms almost solid stands in some places but is always at higher elevations than P. americana and the fruit is quite different from that of the latter as shown in a photograph of

"the wild avocado of Tecpan" which I published in the 1935 Yearbook of the California Avocado Society. We would hope to reproduce this in our paper, along with the wild avocado of Costa Rica from Paul Allen's the "Rain Forests of the Golfo Dulce. There is no reason for considering nubigena a variety of americana if you get away from characters shown only by herbarium specimens.

3. *PERSEA DRYMIFOLIA* Cham. & Schlecht. Ancestor of the Mexican race. No taxonomic problem here. See picture of the fruit in the Yearbook *ubi supra*. We know that this is indigenous from northern Mexico to Guatemala, though it does not occur anywhere in extensive solid stands as does nubigena. We did not think it is native as far south as Guatemala until a few years ago; Schieber has found it widely scattered in this country, but not abundant. The fruits of this species were being eaten by the Mexicans seven or eight thousand years ago. The archeologists have proved this.

Thus we have the background of our three horticultural races. Now for some allied things.

4. *PERSEA JIMENEZII* n. sp. This is our problem child but there is no reason to believe it had anything to do with the origin of any of the three horticultural races. It is the "Vocado de San Isidro" brought to the attention of horticulturists in the 1935 Yearbook; it is the "aguacate de mico" of Honduras, a tree which occurs from sea coast up to 5000 feet from Honduras to Costa Rica. It was discovered by Oton Jimenez and myself on the slopes of Volcano Irazú and described in the 1927 Yearbook of the California Society. Figured, good fotos, in the 1935 Yearbook. Strongly anise scented in bark, leaves and fruits. It has been collected by Antonio Molina in Honduras. I believe there are herbarium specimens among those I sent to Washington, or rather those in the former herbarium of the Office of Foreign Plant Introduction

which is now at the National Arboretum. Dr Kopp did not have this material when she wrote her monograph. Why don't you describe it, and name it for Oton Jimenez who took part in its discovery and who has done a lot for Costa Rican botany? The photos in the Yearbook 1935 give you a good basis for the description; the herbarium material probably will not show it markedly different from P. americana. Incidentally, you suggest calling it P. nubigena var. guatemalensis. It seems closer to americana than to nubigena. It definitely is not a true cultigen. It is not in my patio in Matigua. The fruit, as Antonio Molina can tell you, is not much eaten by men; to some extent by animals.

5. PERSEA STEYERMARKII Allen. Mexico and Guatemala. Very close to nubigena, but the tree is different in appearance; the venation of the leaves different; and the fruits smaller than nubigena as a rule, with practically no flesh around the large seed. It has had nothing to do with the development of the horticultural races.

6. PERSEA SCHIEDEANA Nees. Mexico to Costa Rica. Sea level up to 5000 feet. Rather variable, more so than P. nubigena for example (if we are talking of trees in the wild, no horticultural derivatives. Of considerable horticultural interest.

7. PERSEA FLOCCOSA Mez. A rare species from the Mexican states of Puebla and Chiapas, perhaps elsewhere. Considered close to nubigena, but the leaves are more pubescent, and the fruits, which are of about the same size as those of nubigena, have thicker epicarps. Not seen in the lowlands. Said to have been crossed with a nubigena cultivar in California. Not seen in the lowlands.

8. BIELSCHMIEDIA (Hufelandia) AVAY. While not a Persea, its fruit looks much like a long pear shaped fruit of the Mexican race of avocados. It is quite edible but so far as know is not planted for its fruit. Lowlands of Mexico and Guatemala, as far as known to us.

9. HYBRIDS. It is safe to say that many of the best commercial avocados of the present day are hybrids. Practically all of them are natural hybrids of which only the pistillate parent is certainly known, but plant breeders in Florida and more particularly in California have produced by controlled pollination and undoubtedly more will appear in the future. Among commercial varieties now cultivated extensively are hybrids between P. americana and P. nubigena (especially in Florida); P. drymifolia and P. nubigena; and trees have been observed in Mexico, Ecuador and perhaps elsewhere which are believed to be hybrids between P. americana and P. drymifolia.

So there you have our story. Think it over, Luis, and let us know if dont think we had better proceed on the above basis. The only problems really are, (1) to get rid of botanical varieties of Persea americana and to get the avocado de San Isidro (aguacate mico named and described. If you are going to do this job, and do not like to use the name Jimenezii, then see if you can figure out a name which will recognize the strong aromatic flavor, the strongest we know in any Persea.

Let us hear from you soon. I want to finish up my part, If you agree with our conception of what constitutes a good species, look up the illustrations of the avocado de San Isidro and P. drymifolia in the 1935 Yearbook, and Paul Allen's excellent foto of P. americana in the Rain Forests of the Golfo Dulce.

Warmest regards to Ana and yourself,

Faithfully yours,

Antigua, Guatemala 6 Feb 1975

Dr George Zentmyer
University of California
at Riverside.

Dear George:

Referring to your letter of 27 January, I have been in correspondence with Stuart Dawes of New Zealand (who spent several in Antigua a couple of years ago) about good schiedeanas. I would like to help Stuart, who is a real plantsman, but like yourself, I have never seen and schiedeanas worth propagating except the one figured in my bulletin 743. And whenever I look at that Plate XIII I ask myself if that fine schiedeana on the left could possibly have been a hybrid between the Guatemalan avocado and *P. schiedeana*? I have never seen another chinini, coyo or chucte half as fine as that one. When I found the original tree of that possible "hybrid" I sent budwood to Washington, but they never got the variety established anywhere. I think the curious fact is that neither you nor I have ever seen what we believed to be a hybrid between these two species, spite of the fact that in the Orizaba region - and below there, toward Corfoaba, there are hundreds of chininis and avocados growing almost side by side, in coffee fincas. The best schiedeanas I have ever seen were probably some with quite large fruits on the Pacific coast in Guatemala and El Salvador. Dawes could probably not get any better ones than these. This coming summer I might be able to get some friend to buy some fruits in the market and send me the seeds. But it is an expensive job sending schiedeana seeds to New Zealand by airmail (the only way). It will cost at least a dollar a seed, probably \$1.50, or even \$2. They have raised the cost of gasoline and mailing chinini seeds about one hundred percent recently.

I wonder if you got any flowers of that wild avocado of San Isidro

when you were in Costa Rica recently. I think it simply must be described as a new species (I am suggesting to Louis Williams that he name it Persea Jimenezii in honor of its co-discoverer). I am afraid there are not flowering specimens in any of the herbaria in the States, and I don't believe they have any in the herbarium at San José. I am writing Oton Jimenez about this. I think the herbarium at San José has gotten into bad shape, years ago, after Pittier went to Washington and Venezuela. Oton will know all about it.

I have just found in my files here a fine photo of a little avocado from Toquian Grande, in Chiapas; it looks just like the other nubigenas of which we have fotos, but I only have a picture of an entire fruit. The seed is bound to be round or slightly oblate in form, because the fruit is.

I am having some good fotos made here, from specimens shown in the Yearbooks; my drymifolia from the road to Santa Maria de Jesus, the wild avocado of San Isidro, the nubigena from Tecpan which was the first one mentioned and illustrated in print, and Paul Allen's americana from the Golfo dulce. We will have good material to illustrate the ancestors of the three horticultural races.

Best regards always,

Faithfully yours

Wilson Popenoe



March 4, 1975

Dear Dr. Popenoe:

I don't know how it is that I get involved in so many things but somehow I do. Between us we put nine letters in the mail yesterday morning and somehow or other mail comes not only directly here but quite a bit is sent along from Chicago.

During the last weeks I have been doing a bit of thinking about the possible continuation of the central Central American project and the possibility now of getting some funds to start the production of a synoptic flora. I think it can be turned out in five years and will require five or six person with total stipends of about 60,000 a year, plus travel, plus overhead. I suppose well more than a million dollars in five years. I am not real sure that I want to commit myself for five years. I have just written Fred Hermann to sound him out to see if he might have interest in such a project.

I have been through the page proofs for the Rubiaceae of Guatemala. About 350 pages,- the family is a large one! — Less than two months until we shall have to go back to Chicago and get nose to grindstone.

Now about avocados,- your letter of 29 January in which are the ideas worked out with Drs. Zentmyer and Schreiber in January.

1. Persea americana Miller. It is my feeling that this is the West Indian race, a cultigen but one of ancient Mexican-Central American origin. I do not know from what or how it originated. It must have originated in the Mexican and adjacent Guatemalan area. Through selection and intergression the primitive ancestor may well have been absorbed into the multitude of forms that now make up the cultivated avocados which we now call West Indians. I can not agree that Paul Allen's Costa Rican "find" is the ancestor of the West Indian race. There are too many things ~~/~~ against it although I have to admit that all I know about it are the photographs of the fruits (which I do not have here) and the specimens in the herbaria. It looks too much like a seedling West Indian, the seed of which might have been cast aside recently by someone walking down a trail. Second it is in the wrong place for a progenitor of the West Indian race to be. The center of diversity of avocados (i.e. subg. Persea) is in the Mexican-Guatemalan area and that is where the progenitor should be found. Third, it is in the wrong place also if one considers the direction of migration of ancient man. I suspect that the Lancetilla avocado is the same sort of thing, but again I do not know much about it for I have never seen it wild, i.e. not cultivated.

2. Persea nubigena. I think that we all agree that this is a wildling, although one in which considerable variation is found in its rather extensive range. (Incidentally there will be a good photograph of this from above Purulhá in Time-Life's upcoming book on the "High Jungle.") I am about as sure as one can be that the large-fruited cultigen, ~~the~~ "Guatemalan race", originated from this wildling. I guess that we all agree on this.

2a. I think that P. nubigena var. guatemalensis would prove to be a very useful concept. It should be an excellent way to tie it down scientifically. I see no objection to having a botanical name for a plant that also has a horticultural name as a race. I think George may not understand what a "type" does in tying down a botanical name. It is nothing more than a specimen which

is the "standard." It says, in effect, "This is the basis for P. nubigena var. guatemalensis and if this cultigen is discussed at some later date this specimen must be taken as the standard for such discussion." — This incidentally is why Allen's Palmar specimens can never be considered the nomenclatorial basis for P. americana.

3. P. drymifolia C. & S. I think no problem here, not taxonomically at least. If it is the ancestor of the Mexican race, and you indicate no doubt, how did it come about? Is it possibly a matter of selection through a great period of time? If this is considered to be the case then the Mexican race should be delimited botanically IF this is done for the Guatemalan race, as I would like to do.

Thus for the three horticultural races we have for: the West Indians, no known nor specified ^{wild} progenitor; for the Guatemalans, a known plant assumed to be the progenitor through selection by man; for the Mexicans a presumed wild and certainly cultivated progenitor. Involved are three different species of Persea.

4. P. jimenezii, projected. This, taxonomically, has given me a lot of trouble. I finally thought that it might be a regressant from cultivated P. americana. I am not sure, still, that this may not be so. There was a lot of this just above Tres Rios, apparently not cultivated and certainly hardly worth cultivation. I can not recall at this moment if the plants I collected had strong anis odor or not but the labels may indicate this. Based on the opinion of George and yourself I would be willing to provide a new name. — Anis odor or flavor, as I have written before, is an interesting phenomenon but of little or no systematic value in this genus. — I would dislike bringing the Lancetilla, the Palmar, and assuredly not the don Pompilio avocado, under a name provided for the San Isidro or Tres Rios ~~avocado~~ Persea. — Naming a Persea for don Otón is a grand idea.

5. P. Steyermarkii Allen. Agreed.

6. P. schiedeana. Nees. Agreed

7. P. flocossa Mez. Agreed.

8. Hufelandia or Bielschmiedia anay. I never saw but the one that you had in your yard in Zamorano. I think all the specimens are missing from Chicago or perhaps there were none. — Miss Allen, as you may know, had thousands of specimens borrowed and at New York Botanical Garden. These may have been returned by now. I was told that she left the garden without telling anyone.

I withdraw, then the concept of an inclusive name for some hybrid swarms of avocados. I will need to reevaluate some collections of P. Jimenezii, projected. The scientific bases for the three races should be uniform and to this end it may be wise to withdraw var. guatemalensis, thus leaving a botanical name at specific level to back each of the horticultural races.

Some of this I can not do until I get back to Chicago. I may wish to talk to Walt Hodge and/or Dick Schultes on designations for races.

My regards,

CC: Zentmyer

Encl. Letter to Molina.

Louis