

T H E S I S

O n

SOME FACTORS AFFECTING THE COOKING QUALITIES OF PEARS

Submitted to the

O R E G O N A G R I C U L T U R A L C O L L E G E

In Partial Fulfillment of the Requirements

For the Degree of

M A S T E R O F S C I E N C E

In

The School of Home Economics

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June 18, 1915.

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OUTLINE FOR THESIS

I. Introduction.

II. Object of Experiments.

1. To determine which varieties of pears are best for canning, preserving, baking.
2. To determine if the masses of grit cells found in pears bear any relation to their cooking qualities.

This was investigated as to,-

- a. Relative size of grit masses.
 - b. Relative number of grit masses.
 - c. Location of grit masses.
 - d. Ease with which grit masses separate from the other tissue.
3. Effect of the various methods of cooking upon the grit cells, and grit masses.
 4. Effect of the various methods of cooking upon the other cells.
 5. Effect upon the grit masses of cooking in a five per cent solution of Potassium Chloride, and in a five per cent solution of Sodium Hydroxide.

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2. Cooking Utensils.
3. Photo micrographic camera.
4. Binocular microscope.

IV. Procedure

1. Miss Russel's experiments.
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4. Cooking and microscopic examination.

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2. Condition of the different varieties of pears.
3. Dehydration and clearing.
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5. Few specimens of each variety.

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Introduction

Because of the desirability of using more fruit in the average dietary, it is important to have variation in the kind of fruit and in the manner of cooking it. Pears are a valuable addition to the diet because of their delicate pleasing flavor, and the mineral salts they contain, but also they have some food value. In this respect they compare very favorably with many other fruits, and also with many staple food articles. The table given below is from "Chemistry of Food and Nutrition", Sherman, page 319, and the figures represent the calorie (A calorie is the amount of heat required to raise the temperature of one kilogram of water to one degree Centigrade) value per pound of edible portion.

Apples	285	<u>Pears</u>	288
Apricots	263	Beets	180
Blackberries	262	Buttermilk	162
Oranges	233	Carrots	204
Peaches	188	Flounder	282
<u>Pears</u>	288	Koumis	234
Red Raspberry	247	Skimmed Milk	167
Strawberries	169	Onions	220
		Oysters	228
		Parsnips	294

Squash	209
Turnip	178

In addition, the pear, as compared with the apple which is our most common fruit, is more digestible, owing to the fact that the flesh is soft and the skin not so tough. (Diet in Health and Disease, Ruhrh & Friederwald, Fourth Edition, p. 132.)

Most of our pears originated in France and Flanders and there they have many more varieties than we have and use more discrimination in the use of each variety for a specific purpose. There the pear is the staple fruit and is used as commonly as we use the apple.

One reason pears are not more extensively used here is that people lack the appetite for them and need to cultivate a taste for pears used in various ways. Another reason is that people are accustomed to think of pears as an expensive fruit because a few choice varieties, which are dessert pears, sell for five to nine dollars a box in the East for high class hotel table trade. But for canning or cooking purposes these pears may not be so good as many others which do not bring the fancy prices.

We do not consider that it is practicable to use our fancy apples for cooking, and should use the same discrimination in the use of pears. On the

local market pears good for cooking purposes may be bought for a dollar per box, so that pears are about as available as apples for use in the household. These prices of course vary with the season, as do prices of apples or any other fruit or commodity.

The season for pears is not so long as that for apples, either in common storage or in cold storage. The approximate seasons in common storage and the average limit in cold storage for the varieties used in this work are given. This is in the locality of Corvallis and is intended only as an average, for the seasons vary in different years.

Variety	Season in Common Storage	Limit in Cold Storage
Anjou	Oct. 15 - Nov. 15	Dec. 15
Belick	Oct. 15 - Nov. 15	Nov. 30
Bordeaux	Sept. 30 - Oct. 30	Nov. 30
Bosc	Oct. 15 - Nov. 15	Dec. 15
Boussock	Sept. 15 - Sept. 15	Oct. 15
Cole	Sept. 30 - Oct. 15	Nov. 15
Comice	Oct. 15 - Nov. 30	Jan. 15
Easter	Oct. 15 - Jan. 1	March 1
Garber	Oct. 15 - Nov. 15	Nov. 30
Idaho	Oct. 15 - Nov. 15	Nov. 30
Kieffer	Oct. 15 - Dec. 1	Jan. 15
Knight	Oct. 15 - Nov. 15	Dec. 15
Le Conte	Sept. 15 - Oct. 15	Nov. 15
Lucrative	Sept. 20 - Oct. 15	Nov. 15

Mt. Vernon	Sept. 20 - Oct. 15	Nov. 1
Patrick Barry	Jan. 1 - March 1	April 1
President	Sept. 30 - Oct. 30	Nov. 30
Seckel	Sept. 15 - Oct. 15	Nov. 30
Winter Nelis	Oct. 15 - Nov. 30	Jan. 1
White Doyenne	Oct. 1 - Oct. 30	Nov. 15
Vicar	Oct. 15 - Nov. 15	Dec. 15

These represent only a very few of the many varieties of pears that are available, and the season probably would approximate eight months of the year when all varieties are considered.

There are opinions as to which varieties of pears are best for certain purposes, such as canning or baking, but these opinions have not been based upon comparison of many kinds, and no study of the cooking qualities of pears has been made.

For these reasons this investigation seems important, and it may be helpful as a basis for selecting pears for use in the home. The problem is large, and of necessity this report is concerned with only a very small part of it, and while it does not treat any phase of the subject exhaustively, it does furnish a comparison between some leading varieties.

Object

The work was undertaken to establish, if possible,-

1. What varieties of pears are best for canning, for preserving, for baking. This was Miss Russel's work.

2. If the masses of grit cells found in pears bear any relation to their cooking qualities other than,-

a. Number

Other factors being the same, the pears having the most grit cells would be the least desirable.

b. Size

Other factors being the same, the pears having the largest grit masses would be least desirable.

c. Location

If the grit masses are so arranged that most of them would be eliminated in peeling and coring, they would not affect the value of the pear for canning, preserving, or pickling.

d. Ease with which grit mass is separated from other tissue. If the tissue around the grit mass clings to it, the mass would not appear so rough and hard and prominent as if the tissue falls away and leaves the grit mass bare.

3. Effect of cooking upon the grit cells and masses. This test was to decide if the various solutions used in cooking cause the grit mass to disintegrate, or its cells to separate, or to soften, or to be visibly affected in any way.

4. Effect upon other cells of cooking by the various methods. If the other tissue of the pear reacts differently in cooking the different varieties, it may be also a factor in deciding which is a better pear for cooking.

5. Effect upon the grit masses of cooking in a 5 per cent solution of Potassium Chloride and Sodium Hydroxide. This investigation was not carried out in detail but merely to see if these reagents would break down the walls of the grit cells or would cause the cells of the masses to separate.

Materials and Utensils

The following varieties of pears were used:

Anjou	Easter	Mt. Vernon
Belick	Garber	Patrick Barry
Bordeaux	Idaho	President
Bosc	Kieffer	Seckel
Boussock	Knight	Winter Nelis
Cole	Le Conte	White Doyenne
Comice	Lucrative	Vicar

The utensils used in cooking were those of the Home Economics Laboratories.

The camera was a Leitz-Wetzlar photo-micrographic camera, lens F : 4.5, summar 120 mm. A Zeiss binocular microscope with oculars 4, and lens A₃ was used in the microscopic work. The camera, microscope, and materials used in this part of the work were furnished by the Research Laboratory of the Department of Horticulture, where the work was done.

Procedure

Miss Anne Russel, a senior student in Home Economics, conducted the experiments to determine which varieties of pears are best for canning, preserving, and baking. By her permission, her report is included here.

I. Object of Experiments

To determine the relative value of a number of varieties of pears for certain cooking purposes: canning, preserving, and baking.

II. Varieties of pears used

Boussock	Idaho
Bordeaux	Vicar
Seckel	Easter
Lucrative	Clarigean
President	Winter Nelis
White Doyenne	Bosc
Cole	Knight
Le Conte	Anjou
Belick	Mt. Vernon
Comice	Patrick Barry
Garber	Kieffer

III. Procedure

1. Description of cooking apparatus

Saucepans, ovens, scales, and other

necessary utensils were used.

2. Methods of keeping results uniform

Baked pears -

1/10 of an ounce of sugar was added to every ounce of pears; weighed after having cores removed. With this amount of sugar they were placed in the oven and cooked until soft.

Canned pears -

A syrup consisting of 1 lb. of sugar to 3 cups of water was poured on the fruit after packing it in the jars. It was then steamed for 2 1/2 hours.

Preserved pears -

Pears were weighed after having been pared and two-thirds as much sugar as pears was used; the amount used each time was 9 oz. of pears, 6 oz. of sugar, and 2 tablespoons of water. They were cooked until soft.

IV. Table showing average score of products:

Canned Pears

Varieties -		Boussock	Bordeaux	Seckel	Lucrative	President	White Doyenne
Flavor							
of Fruit	25	19.5	21	21.2	18.2	14.7	21.5
of Juice	25	19	19.7	21.5	18.7	14.7	21.5
Texture							
Way Cooked up	10	8	9.5	8.5	8.2	9.2	8.5
Tenderness	10	9.2	8.5	9.2	9	8.7	9.5
Grittiness	15	10.5	8	12.2	10.5	11	11.2
Stringiness	5	3.5	4.2	4	3.7	4.5	4.2
Color	10	7	7	9	7.7	8	7.7
Total	100	75.7	77.9	85.6	76	70.8	84.1

Varieties -		Cole	Le Conte	Belick	Comice	Idaho	Vicar
Flavor							
of Fruit	25	20	19	18.8	20.2	18.8	16.8
of Juice	25	20.5	17.8	17.6	19.5	19.6	20
Texture							
Way Cooked up	10	8.7	8.5	9.4	8.2	8.7	8.1
Tenderness	10	8	8.5	8.8	7.6	8.6	8.4
Grittiness	15	8.5	10	12.2	11.6	9.8	11.1
Stringiness	5	4	4.4	4.6	4.3	3.9	4
Color	10	7.5	7.6	8.6	6.9	8.6	8.3
Total	100	77.2	75.8	80	78.3	78	76.7

Varieties -		Easter	Clarigean	Winter Nellis	Bosc	Knight	Anjou
Flavor							
of Fruit	25	17.3	15.6	18	16	21	14.5
of Juice	25	17.3	17	17	17	21.7	15.7
Texture							
Way Cooked up	10	8.7	7.5	7.6	8.5	8.6	8.8
Tenderness	10	9.4	4	8.1	8	9	9
Grittiness	15	11	7.1	10.8	7.7	10	7.5
Stringiness	5	4.1	3.1	3.3	4.5	4.5	4.3
Color	10	8.4	4.8	7.5	6.7	7	8.2
Total	100	76.2	59.1	72.3	68.4	81.8	68

Varieties -		Mt. Vernon	Patrick Barry	Garber	Kieffer
Flavor					
of Fruit	25	18	19.5	17	18.5
of Juice	25	20	20	19	19
Texture					
Way Cooked up	10	9.1	9.5	7.5	7
Tenderness	10	9.5	9	6.5	5
Grittiness	15	8.2	11.2	11.5	6
Stringiness	5	4.7	4.8	4.5	4
Color	10	7.6	8.2	7	7.5
Total	100	77.1	82.2	73	66

Varieties -		<u>Preserved Pears</u>					
		Boussock	Bordeaux	Beckel	Lucrative	President	White Doyenne
Flavor							
of Juice	20	16	17	18.5	16.5	16.5	16
of Flesh	20	15	18.5	17.7	16	18	17.2
Texture							
Way Cooked up	10	7	8.7	9.2	8.5	6.2	8
Tenderness	10	8.5	8	7.2	7.5	9.2	9
Shape	10	7.2	9	8.7	9	6	7.2
Grit	10	6.7	7.5	6.7	7.2	8.3	7.7
Color	20	15.2	16.7	18	17.2	16.2	16.5
Total	100	75.6	85.4	86	81.9	80.4	81.6

Varieties -		Le Conte					
		Cole	Bellick	Comice	Idaho	Vicar	
Flavor							
of Juice	20	15.7	17.4	16.8	15.6	17	15.1
of Flesh	20	17	16.8	16.6	15.2	15.6	13.5
Texture							
Way Cooked up	10	6	8.4	9.2	8.2	8	8.5
Tenderness	10	6.2	7.8	9	8.4	7.2	7.6
Shape	10	6.5	7.6	9.2	8.2	8.2	8.1
Grit	10	5.6	6.8	8.1	7.4	6	7.5
Color	20	15.2	16.6	17.6	16.8	17.6	15.1
Total	100	72.2	81.4	86.5	79.8	79.6	75.4

Varieties -		Easter	Clarigean	Winter Nellis	Bosc	Knight	Anjou
Flavor							
of Juice	20	17.5	13.1	15.6	13.2	13	17.2
of Flesh	20	15.1	11.3	17.0	13	17.7	17.5
Texture							
Way Cooked up	10	8.6	6	8.3	5.7	7.5	6.7
Tenderness	10	9.0	5.5	8.8	4.2	9.2	8.7
Shape	10	8.1	7.0	7.9	6.2	7.5	6.7
Grit	10	8.0	3.5	7.1	4.5	7.5	7.5
Color	20	17	10	12.3	10	16.5	13.2
Total	100	83.3	56.4	77	56.8	78.9	77.5

Varieties -		Mt. Vernon	Patrick Barry	Garber	Kieffer
Flavor of					
of Juice	20	16.2	13.4	17.5	15.5
of Flesh	20	16.7	16.5	16.7	17.5
Texture					
Way Cooked up	10	8	8.2	7.5	7.5
Tenderness	10	8.2	8.1	4	3.5
Shape	10	7.2	8.2	8.5	7.5
Grit	10	5.2	7.5	5.5	3
Color	20	16	15	16	16
Total	100	78.1	76.9	75	70.5

		<u>Baked Pears</u>					
Varieties -		Boussock	Bordeaux	Seckel	Lucrative	President	White Doyenne
Flavor	60	43.8	52.5	51.5	42.5	44.5	41.2
Texture							
Way Cooked up	8	7.5	6.7	6.7	6.7	6.5	6
Tenderness of Flesh	8	7	6.5	7.2	7.2	6.7	6.6
" Skin	4	2.7	2.8	2.7	2.5	2.8	2.7
Grit	10	6.7	6.6	6.7	5.7	7.2	7.2
Color	10	9	8.2	7	7.7	8	7.5
Total	100	76.7	83.3	81.8	72.3	75.7	71.2

		Cole	Le Conte	Belick	Comice	Idaho	Vicar
Varieties -							
Flavor	60	43	26	44.5	46.6	41.8	40.5
Texture							
Way Cooked up	8	7.2	6.1	6.2	7	6.3	6
Tenderness of Flesh	8	6.3	6.1	7.5	7	6.1	5.6
" Skin	4	2.3	3	1.6	2.8	2.6	2
Grit	10	5.6	5.3	7.3	7.3	6	6.6
Color	10	8.5	7.1	7.5	7.8	6.8	7.5
Total	100	72.9	53.6	74.6	78.5	69.6	68.2

Varieties -		Easter	Clarigean	Winter Nellis	Bosc	Knight	Anjou
Flavor	60	41.3	33	43.6	38.7	54.2	56.5
Texture							
Way Cooked up	8	6.3	4.5	6	4.2	7.1	7.7
Tenderness of Flesh	8	6.2	5	6.4	2.7	7.7	8
of Skin	4	2.4	2.3	2.6	2	2.8	2.8
Grit	10	7.3	2.6	2.6	5.2	7.2	7.6
Color	10	7.6	5	7.8	5.7	8	8.3
Total	100	71.1	52.4	68.4	58.5	87	90.9

Varieties -		Mt. Vernon	Patrick Barry	Kieffer
Flavor	60	52	40.7	20
Texture				
Way Cooked up	8	6.5	5.5	4.5
Tenderness of Flesh	8	6.7	6.5	3
" Skin	4	2.1	2	2
Grit	10	5.8	7.6	5
Color	10	7	7	5.5
Total	100	80.1	69.3	40

It is interesting to note the scores of these varieties, judged as dessert pears, on a basis of 10, as given in Bulletin No. 8, Division of Pomology, U. S. Department of Agriculture.

Anjou	8-9
Bordeaux	6-7
Bosc	8-9
Boussock	7
Comice	8-9
Easter	5-6
Garber	3-4
Idaho	8-9
Kieffer	4
Le Conte	3-4
Lucrative	8
Mt. Vernon	5-6
Seckel	9-10
Vicar	4-5
Winter Nelis	8-9
White Doyenne	9

The five varieties which are not scored in the Bulletin were estimated by Professor V. R. Gardner to score about as follows:

Belick	4-5
Cole	6
Knight	8
Patrick Barry	4
President	7-8

Mid sections of each variety cut lengthwise and crosswise were dehydrated and placed in xylol for clearing and preservation. Miss Russel prepared these sections. Later these sections were photographed, because the photograph shows more clearly the sizes, numbers, and location of grit masses than a written description could.

The photographic process was as follows:

The section was immersed in equal parts of cedar oil and xylol in a glass cell which was placed in front of the lens and photographed by light transmitted from an arc light. The diffusion screen and condenser were used, and the camera so adjusted that the photographs are exact size. The time of exposure varied, according to thickness of the section, from one minute to two minutes. The plates were the 4 x 5 Cramer dry plates.

Then the plates were developed and the back ground blocked out with Eastman's Opaque. After trial proofs had been made, forms were made for printing the photographs on to the large leaves for the thesis, and each negative was tried for time of exposure and development so that all prints on a page might finish developing at the same time. These prints were studied for sizes, numbers, and location of the masses of grit cells, and general internal anatomy and proportion.

Small pieces of the dehydrated and preserved material were embedded in parafine, sectioned, and mounted. This method was not satisfactory as the parafine was so brittle that the material shattered rather than sectioned.

Other pieces of each variety were embedded in celloiden, sectioned, and mounted. By this method sections were cut at 40 through the grit masses although a few of them tore out instead of cutting.

These sections were studied to get the differences in cell structure in different varieties, relation of other cells to grit cells, and if cooking quality depends upon any peculiarity of structure.

Small pieces of each variety of the same dehydrated material were hydrated and cooked in various solutions.

First they were boiled in water

Then other sections were boiled in a syrup of 14° density such as is used in canning.

Then others in a syrup of 32° density such as is used for preserving.

Then others in a syrup of 14° density with one-third as much lemon as pear added, and cooked down as in a marmalade.

Finally, others were cooked in a solution of vinegar, sugar, and spices such as is used in pickling.

Each section was examined microscopically to determine the effect of these various methods of cooking upon the grit cells and upon other cells. It was not possible to bake these small pieces of pears.

A section of each variety was cooked in a five per cent solution of Sodium Hydroxide, and other sections in a five per cent solution of Potassium Chloride, and then examined microscopically to see if the grit cells or grit masses were visibly affected.

Results

The cooking did not in any case affect the grit masses or grit cells, so that they affect the score of the pear through number, size, and location.

While there seems to be no possibility of deciding which varieties have the most grit masses, the

Anjou

Cole

Idaho

Kieffer

Mt. Vernon

Vicar

seem to have more and the

Comice

Lucrative

White Doyenne

less than the average.

But the large masses are more prominent than small masses, and the varieties having very large masses are,-

Easter

Garber

Kieffer (very many)

Knight

Le Conte

Mt. Vernon

President

But of these varieties the largest grit masses in the

Easter

Knight

Le Conte

Garber

are grouped around the pith, and probably would be removed to a great extent in coring, and hence may not lower the score to the extent that might be expected.

The following varieties have many grit masses consisting of one cell, or two, three, four, five, or very few grit cells and these very small grit masses are much less conspicuous than the larger ones, and hence these varieties may have a higher score than others which have less grit masses but of larger size.

Seckel

Easter

Knight

Le Conte
Winter Nelis
Belick
Bosc
Vicar
Boussock (few)
Mt. Vernon

All varieties have many grit masses grouped close together just under the skin, but these are removed in paring.

Of the canned pears scoring highest for grittiness the Seckel and Belick each stand 12.2 out of a possible 15. But the Seckel has a total score of 85.6 while the Belick has a total score of 80 due to factors such as flavor.

Of the other varieties scoring highest for grittiness in the canned product

Comice	11.6
Garber	11.5
Patrick Barry	11.2
Vicar	11.1
White Doyenne	11.2
Easter	11
President	11

all score low in flavor except the White Doyenne, which is high, and the Patrick Barry which is good.

Of the six scoring lowest on account of grittiness

Cole	8.5
Bordeaux	8
Mt. Vernon	8.2
Bosc	7.7
Anjou	7.5
Kieffer	6

the flavor averages as high as these given above except in the Bosc and Anjou which are very low in flavor.

Of the varieties scoring highest for grittiness it is probable that in case of the Belick and Seckel the high score is due to the fact that they have so many grit masses of one or very few cells. In case of the Comice and White Doyenne the high score for grittiness may be due to number and location and size for there seem to be fewer grit masses in these two varieties, and the masses are not large except those near the center which would be removed in coring.

In case of the Garber, Patrick Barry, Vicar, Easter, and President the high score probably is due to the largest grit masses being located where they would be removed in coring and paring. The easter and Vicar have some very small grit masses also. Hence it is evident that a high score for grittiness depends upon at least the three factors of number, size, and location of the grit masses.

The pears scoring lowest have large or medium masses throughout the pear. The same explanation applies

in the Preserved Pear where the highest scores are

President 8.3 out of a possible 10

Belick 8.1

Easter 8

and the

Kieffer 3

Bosc 4.5

score the lowest. The next lowest are

Garber 5.5

Cole 5.6

Idaho 6

In this case Garber is one of the lowest, though it was high in the canned product.

In general, the cells around the grit masses tend to cling to them rather than to other cells when a portion of the pear is torn to pieces. This is not affected by cooking. But in some varieties the surrounding cells cling to the grit mass more tenaciously than in others where many grit masses may tear partly loose, i.e., the cells on one side may pull away partly.

In the following varieties, the grit masses, particularly the large ones, quite easily break partly loose from the surrounding cells:

Kieffer

Knight

Le Conte

Idaho

Boussock

Cole

Mt. Vernon

Comice

This tendency might affect unfavorably the score for grittiness in these varieties.

In these varieties the grit masses generally cling to the surrounding cells so that the break is between groups

Seckel

White Doyenne

Anjou

Easter

Winter Nelis

Belick

Garber

Bosc

Patrick Barry

Bordeaux

Vicar

President

Lucrative

It would seem that this also might be a factor in giving a better score for grittiness since the grit masses would be enveloped in this covering of other cells so that they would not seem so sharp and prominent.

In general, the cells around grit masses are so arranged that they seem to radiate from it. When

these radiating cells of one grit mass directly join those of another grit mass, the break, in tearing a section, is between radiating cells of the groups.

The radiating cells of one mass are contiguous to those of another mass in the inner part of the cortex. In the central part of the cortex the structure is less regular and compact, cells are larger, coarser, more oval, and radiating cells are not so prominent. In the outer part of the cortex radiating cells become prominent again and other cells are smaller and more regular. While this is true in general, there are differences in varieties as to sizes of cells, arrangement, and prominence of radiating cells. Some characteristic differences in cells are represented in the drawings.

In cooking in water, a small area lying next to skin is darkened. Less area is darkened in cooking in syrups than in water. The transparency and gelatinous quality of the pear increase with the density of the syrup. In the marmalade, a greater firmness or toughness of the tissue seems to accompany this increased transparency and gelatinous quality,- due probably to the latter quality,- and the cells separate less easily.

A few varieties, while becoming more clarified, do not become transparent and are uniformly darkened. This is due to something in the cell contents that is

in a streak or a spot and gives the entire mass a dark mottled appearance. These varieties are

Bordeaux

Garber

Bosc (slightly)

Patrick Barry (slightly)

Boussock

Cole

Vicar

President

Mt. Vernon

In the pickling solution the following varieties became softer:

Anjou

Boussock

Comice

Easter

Garber

Knight

Le Conte

President

Seckel

Vicar

White Doyenne

and these varieties seemed to be slightly firmer,-

Bordeaux

Cole

Idaho

Kieffer

Patrick Barry

Winter Nelis

While there was no change in the remaining varieties.

Cooking in Potassium Chloride and Sodium Hydroxide made the texture of the pear softer, and the grit masses more easily separated from their surrounding cells. The walls of the grit cells apparently were not affected, but in Sodium Hydroxide the grit mass seemed slightly less brittle and hard. This was true for all varieties.

As in all experiments, there are possibilities of errors that may give rise to wrong conclusions. Among these are:

1. Errors due to individuality of judges who scored Miss Russel's cooked products.
2. Possibility that the results obtained may not be the same as would be obtained in working with fresh fruit when each variety is at its best, as dehydrating the fruit and preserving it in Xylol may affect the cell structure.
3. Possibility that the difference in the condition of the pears when they were preserved may affect the result. All the pears were mature, but were not in the same stage of ripeness. Some were at their best, some over-ripe, and some much under-ripe.

4. The small sections used for cooking for the microscopic examination, as compared with the amount ordinarily cooked, might lead to erroneous conclusions.
5. It is probable that all varieties should not be cooked the same length of time, but in cooking the small sections for microscopic study it was not possible to determine the best time for each piece since many were soft before cooking.
6. No attempt has been made to establish any facts for a given variety as not enough specimens of each variety were available, but merely to draw some conclusions from comparisons of the different varieties.

Conclusions

From these results we may conclude:

1. That the grit cells or grit masses are not affected by cooking in the ordinary solutions used in cooking pears. Hence they affect the value of the pear only because of size, number, and location, but these factors may be modified as stated.
2. That the grit cell does not have ordinary cellulose walls.

3. That the cooking value of pears does not depend upon grittiness alone but to a great extent upon flavor.
4. That there is no definite relation between flavor and grittiness.
5. That good dessert pears may not be equally good when cooked, although the Seckel ranks high both as a dessert pear and in the cooked products.
6. That desirable qualities in pears depend first upon chemical composition which determines the flavor, and second upon morphological structure.
7. No definite relation was established between cooking scores and size, shape, or arrangement of the cells of the pear.

Acknowledgements

The writer wishes to express her appreciation of the many helpful suggestions given by Professor Ava B. Milam under whose direction the work was carried on. The study of the morphological structure of the pear was made in the Research Laboratory of the Division of Horticulture under the direction of Professor E. J. Kraus to whom the writer gratefully acknowledges her indebtedness for much assistance in conducting the investigation.

Thanks are due Professor V. R. Gardner for helpful data, Miss Anne Russel for permission to include

her report, and Mr. A. F. Barss for assistance with mechanical details. Professor C. I. Lewis aided in offering facilities for carrying on the work.

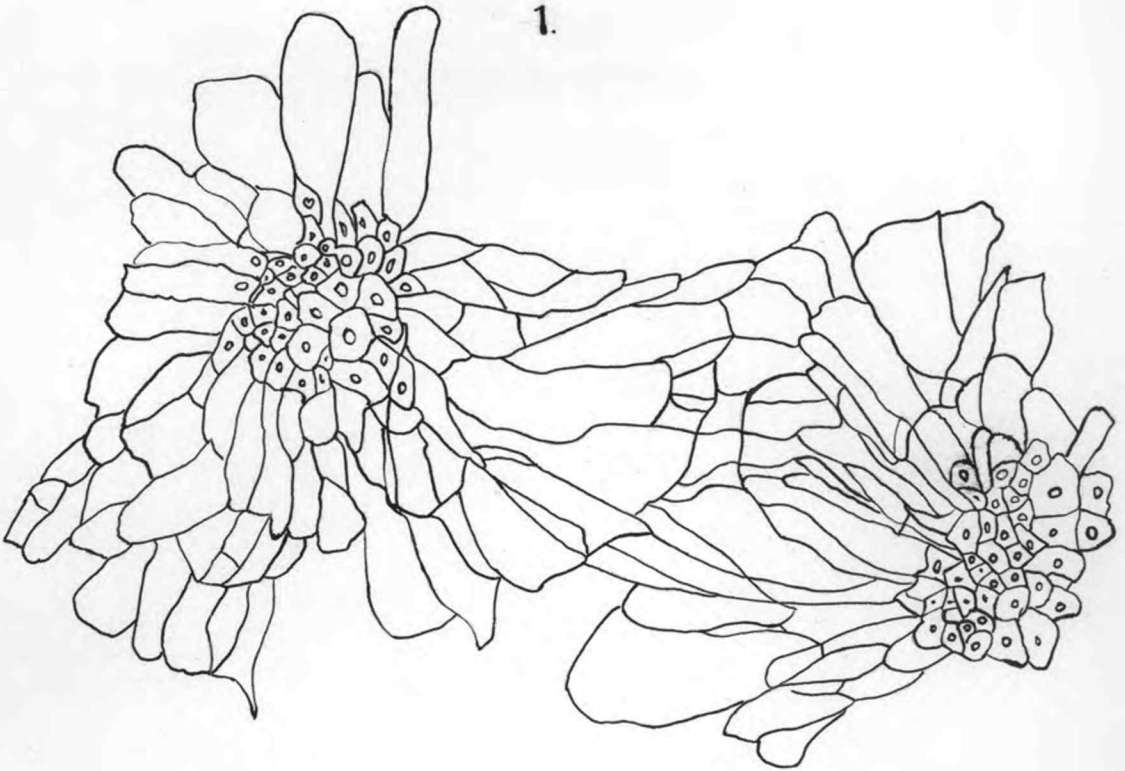
The pears were furnished through the courtesy of the Department of Horticulture.

Cells and grit masses from
the central part of the cortex, drawn
by aid of the camera lucida, and
then photographed.

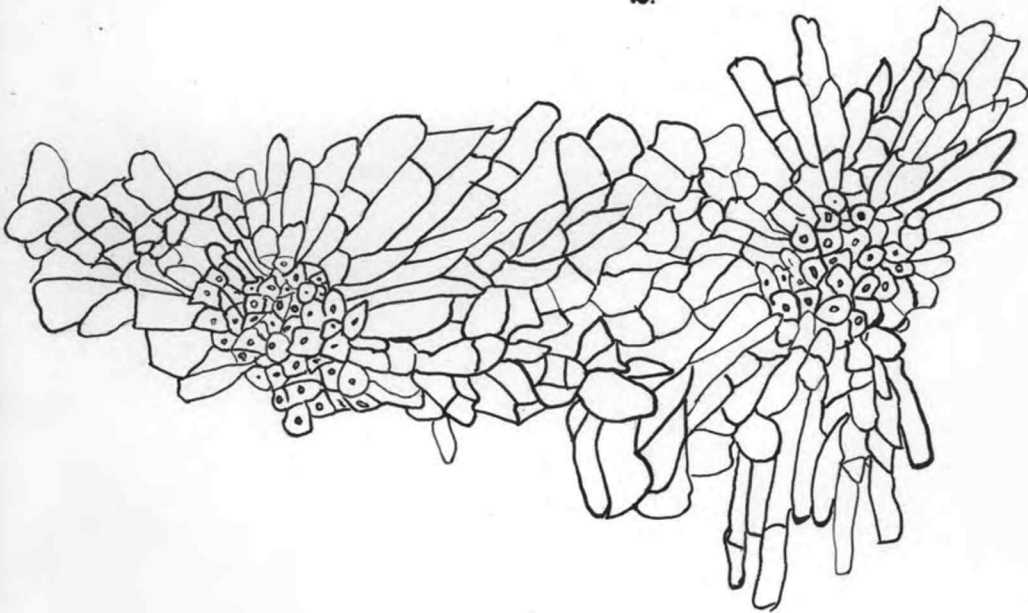
Figure 1, Kieffer

Figure 2, Comice

1.



2.

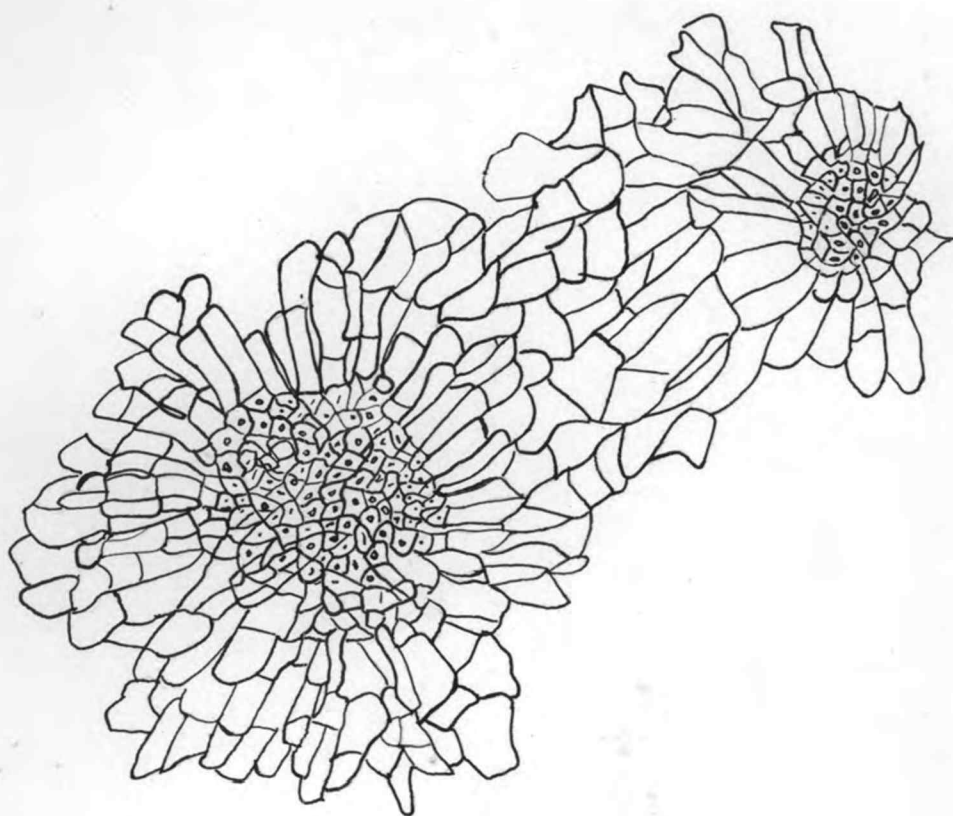


Cells and grit masses from
the central part of the cortex, drawn
by aid of the camera lucida, and
then photographed.

Figure 1, Bordeaux

Figure 2, Seckel

1.



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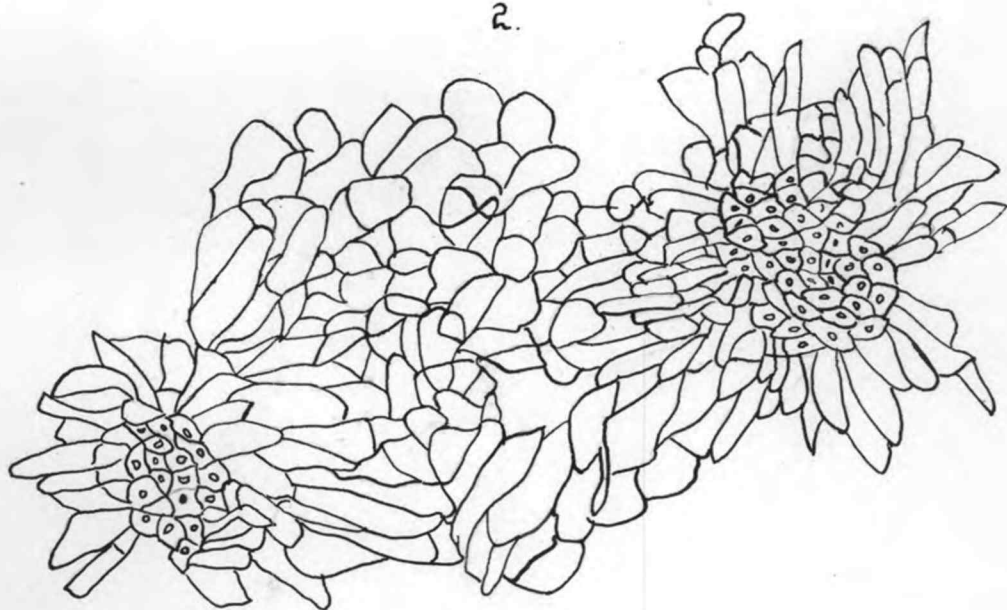


PLATE I

Figure 1, Seckel

Figure 2, Seckel

Figure 3, Kieffer

Figure 4, Kieffer

Figure 5, White Doyenne

Figure 6, White Doyenne

I

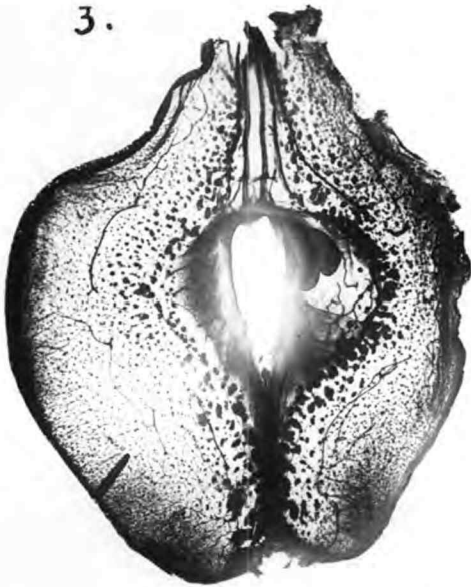
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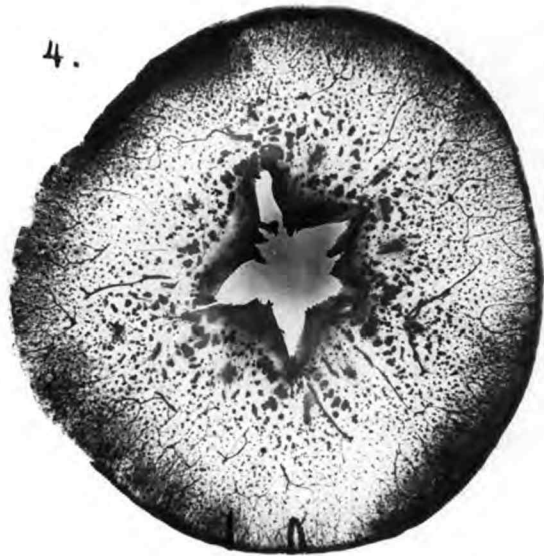
2.



3.



4.



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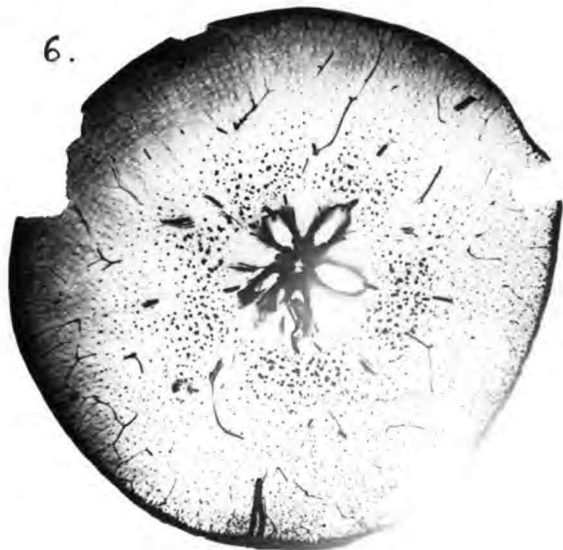


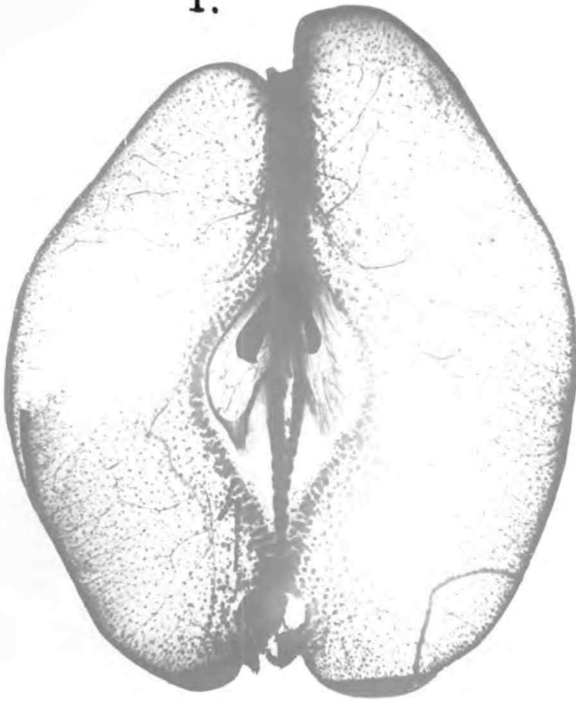
PLATE II

Figures 1 and 2, Easter

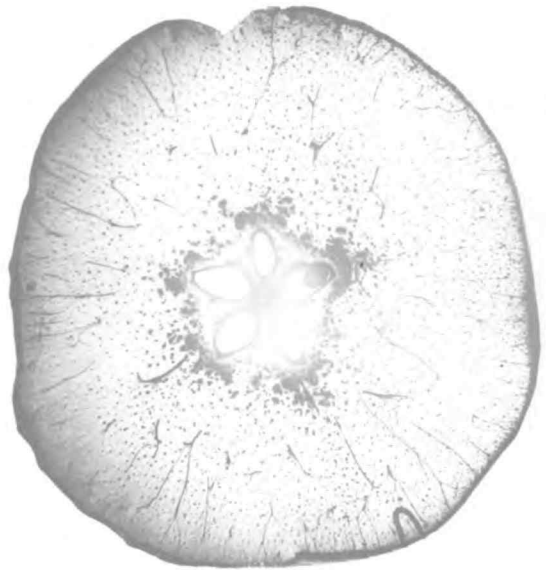
Figures 3 and 4, Anjon

II.

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3.



4.



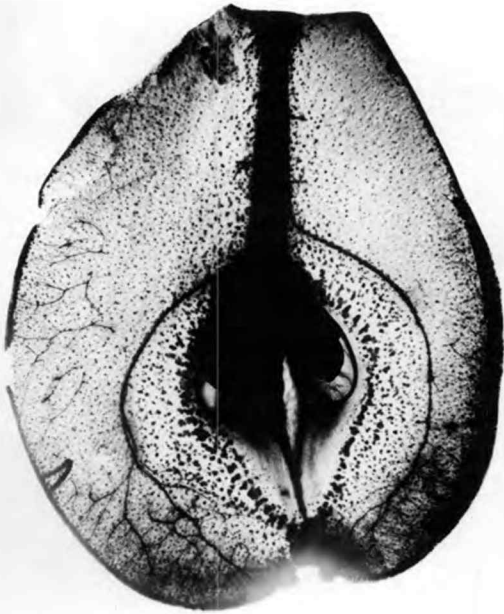
PLATE III

Figures 1 and 2, Knight

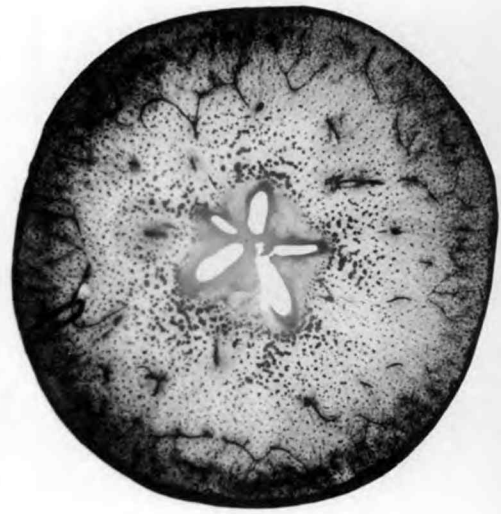
Figures 3 and 4, Le Conte

III.

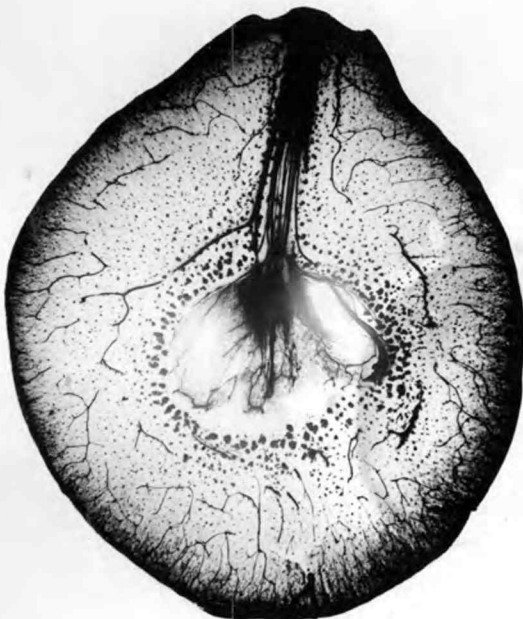
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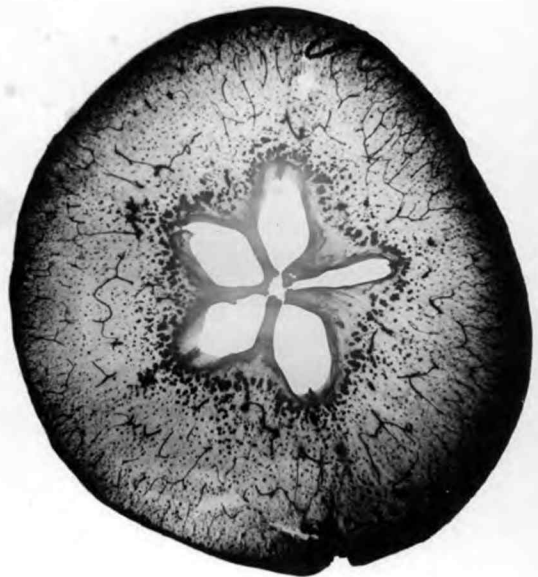


PLATE IV

Figures 1 and 2, Winter Nelis

Figures 3 and 4, Belick

Figures 5 and 6, Idaho

IV.

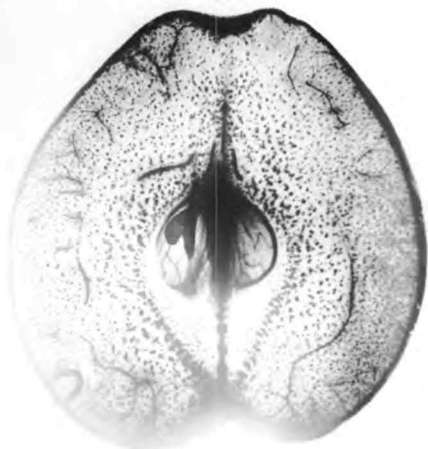
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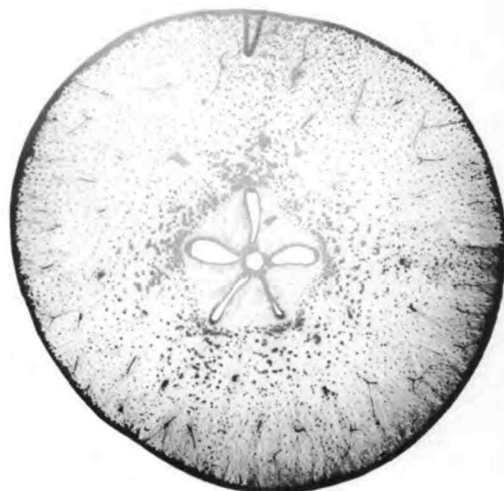
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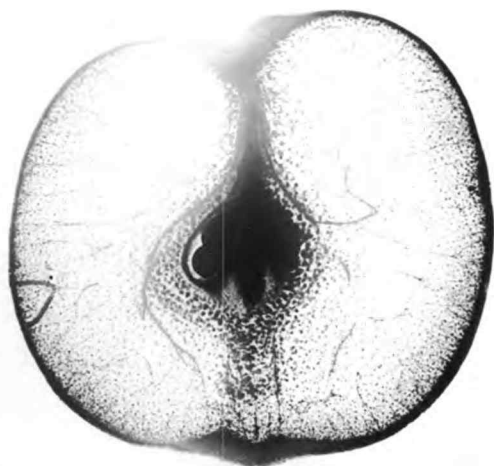
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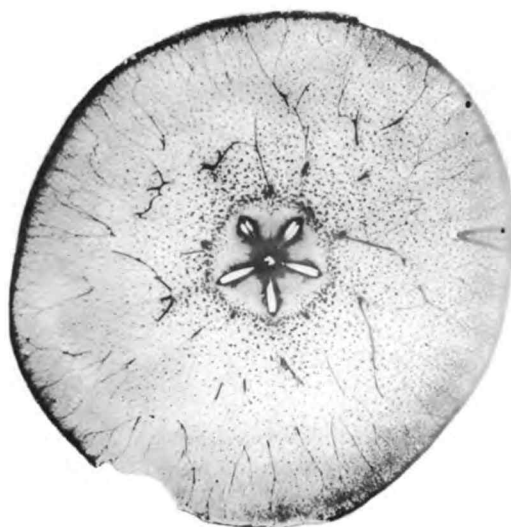


PLATE V

Figures 1 and 2, Garber

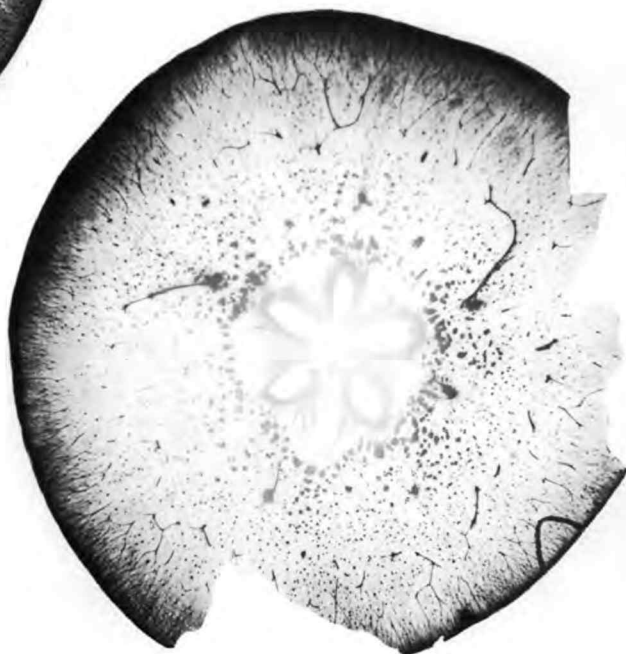
Figures 3 and 4, Bosc

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PLATE VI

Figures 1 and 2, Patrick Barry

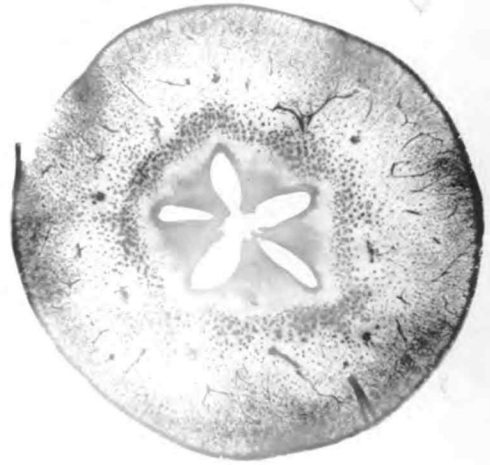
Figures 3 and 4, Boussock

VI.

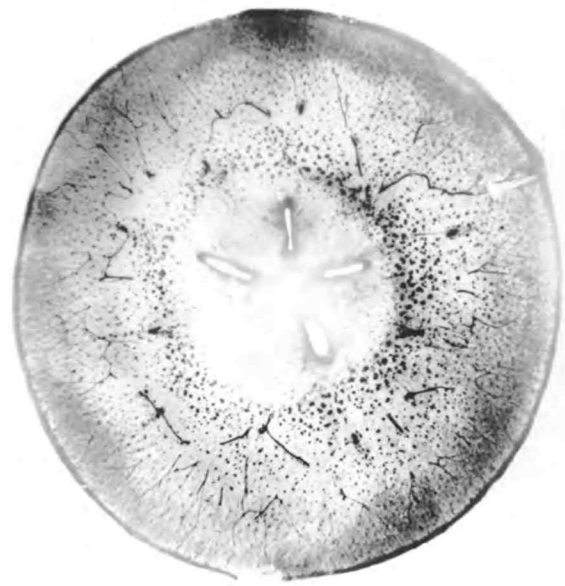
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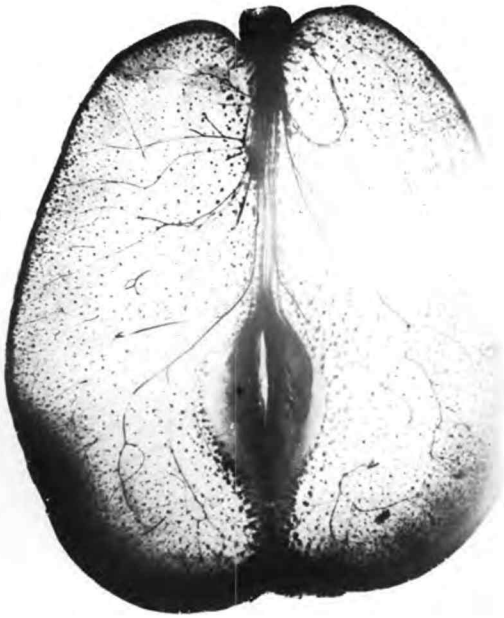
PLATE VII

Figures 1 and 2, Bordeaux

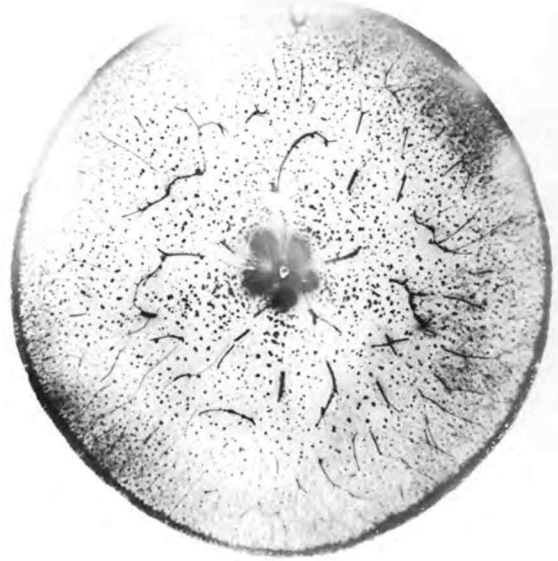
Figures 3 and 4, Cole

VII.

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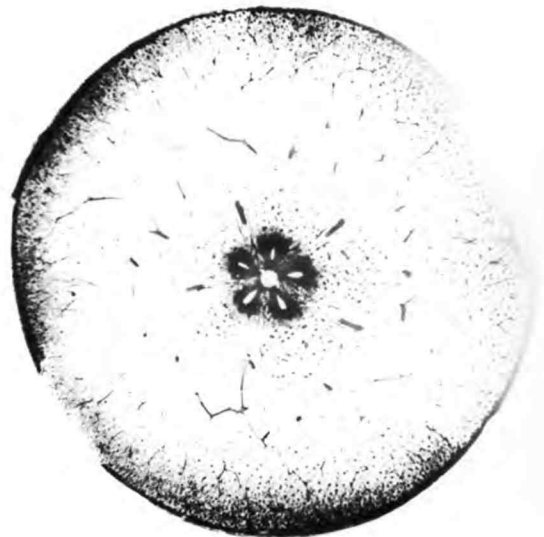


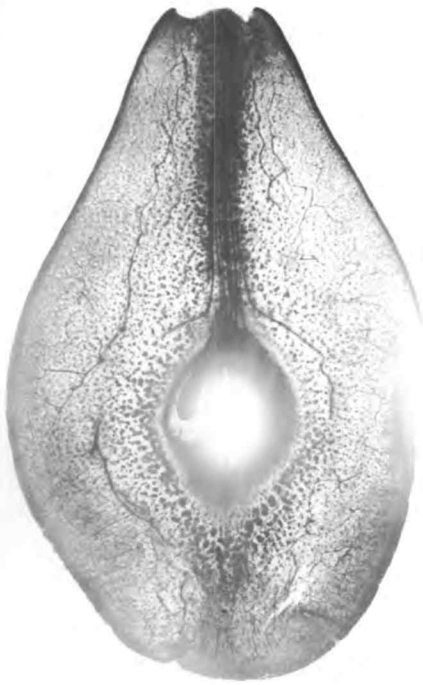
PLATE VIII

Figures 1 and 2, Vicar

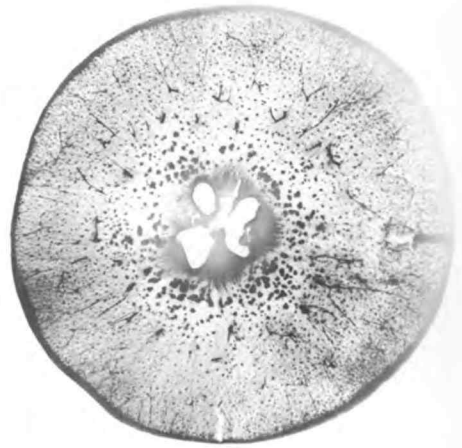
Figures 3 and 4, President

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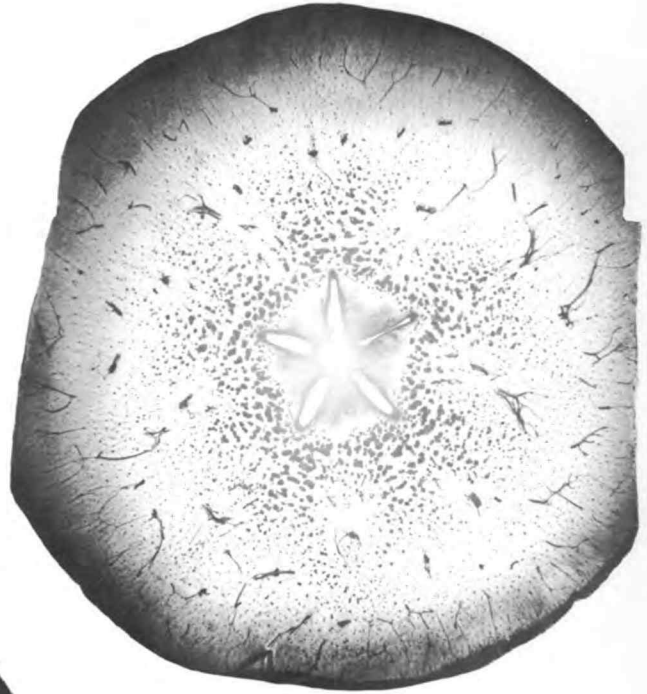
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PLATE IX

Figures 1 and 2, Mt. Vernon

Figures 3 and 4, Comice

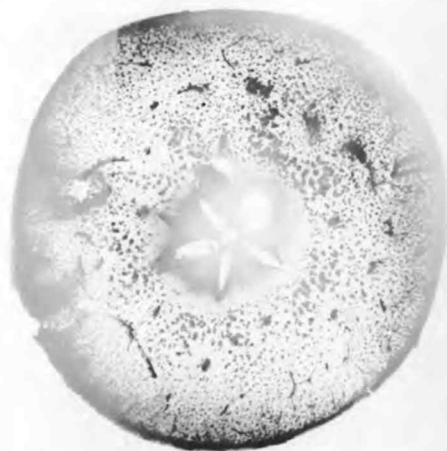
Figures 5 and 6, Lucrative

IX.

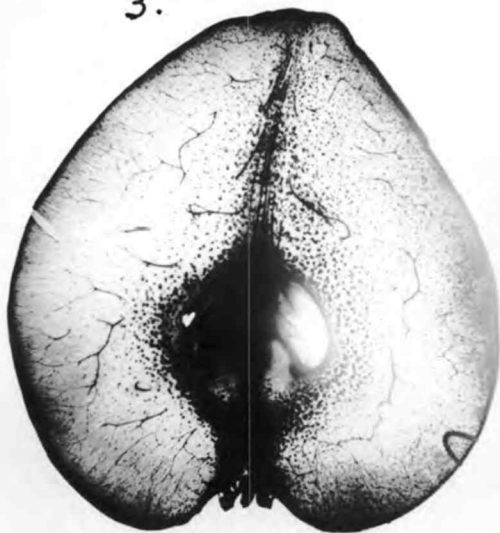
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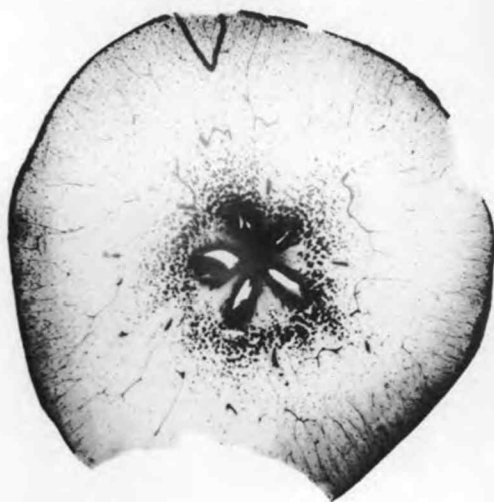
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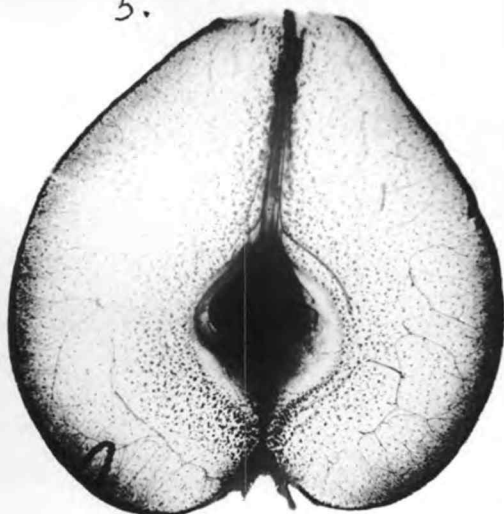
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