
Oregon Agricultural College Experiment Station

Division of Horticulture

Preliminary Report of Pear Harvesting and Storage Investigations in Rogue River Valley

BY

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SUMMARY

Investigations concerning the harvesting and storage of pears were conducted with the following varieties: Bartlett, Bosc, Howell, Anjou, Comice, and Clairgeau.

Fruit was gathered from eight different orchards representing different soil types and subject to different soil treatments.

A sufficient number of trees was selected in each orchard to supply all the fruit needed and fruit was picked entirely by those having the investigation in charge.

The first picking was made slightly in advance of the first commercial picking for that variety in the Valley.

Three boxes of fruit were removed at a picking and all fruit from certain limbs chosen removed at one picking; branches representing top, side, and bottom of tree were selected for each picking.

Fruit was picked at intervals of four or five days throughout the season.

After being picked, the fruit was taken immediately to packing houses, placed in half boxes, six lots being packed out for storage; 45 to 60 pears of each lot were placed in each type of storage. Average samples were chosen from each lot for determination of starch content, specific gravity of juice, and chemical analysis for sugars, acids, and moisture.

Fruit was stored under six different conditions.

- (a) Common Dry or Ventilated Storage
- (b) Common Humid Storage
- (c) Car Temperature Storage
- (d) Cold Dry Storage
- (e) Delayed Storage
- (f) Cold Humid Storage.

The average size of the fruit in each lot for the different varieties is shown in Table I.

The investigations show that where it is possible to leave fruit on trees a short time longer than the average practice, a very great increase both in size of tonnage and size of pack can be secured.

A study was made of the influence of thinning fruit during the harvest season in comparison with harvesting practically all the fruit at one time. Fruit from trees that had no pears removed during picking

season was compared with that from trees from which most of the crop had been removed. Almost no difference in size could be detected; while the thinning of a heavily loaded tree undoubtedly aids, to a certain extent, the "sizing up" of those fruits remaining, nevertheless trees untouched will "size up" fruit a good deal.

Bartletts from non-irrigated orchards did not increase in size nearly as much as Bartletts from irrigated orchards.

There is a correlation between time of picking and quality of fruit secured; fruit from earliest pickings tends to be astringent and puckery but fruit from the third and fourth pickings on is of excellent quality and nearly uniform in flavor and texture. These results were even more pronounced in the later-keeping varieties than with the Bartlett. Early pickings of Clairgeau, Anjou, and Bosc were practically worthless because of flat insipid taste.

A careful study was made to determine if possible the best time to pick Bartletts in order to give them the longest keeping season. In Common Storage at a temperature of 70° F. the earliest-picked Bartletts held up the longest; there was a marked difference, however, where other types of storage were used. In Car Temperature, Cold, or Cold Humid Storage somewhat later pickings invariably held up longer than did the first ones. Table II shows that the third and fourth pickings kept better than those picked earlier or later; this held true even when storage temperatures ranged as high as 50° to 60°. Indications are that with Bartletts the best keeping quality would be attained by leaving fruit on the tree until slightly later than was practiced in 1917.

There seemed to be no correlation between size of fruit and keeping quality of pears picked from the same tree at the same time. Evidently no difference occurs in maturity of fruit, as both little and big fruits ripened together and decayed together.

From our first year's investigation it would seem best to leave all of the crop on the trees until the best time to pick, and then to remove the entire crop at once, or at least as much as is going to be marketed fresh; letting the fruit hang longer will mean deterioration in keeping quality.

Where pears are marketed through canneries, a great increase in tonnage can be gained by leaving the fruit on the trees until it has reached its fullest development.

Results secured with later varieties were identical with those secured with the Bartlett; the time of harvesting is not as acute a problem, however, as there is ample time to get these later varieties to market before they become ripe. The first pickings of Bosc, Comice, Anjou, Clairgeau, and Howell all held up longest at 70° storage, both Humid and Dry. In lower temperatures, however, pickings made later invariably held up longer than did the earlier pickings.

The tendency of growers in the Valley has been to pick their later varieties too early. By leaving the fruit on the trees longer a gain will

be made in size, keeping quality, and eating quality. The only justification for picking such varieties early is to escape damage from wind storms.

In Humid 70° Storage, Bartletts were entirely gone in 12 to 25 days. Bosc, Howell, Comice, and Anjou ripened and decayed within 25 days. Since the ventilation in the room was poor, it is impossible to say whether temperature, high humidity, or the accumulation of carbon dioxide or other gases was responsible for poor keeping.

Well-ventilated fruit kept longer in 70° Dry Storage than in 70° Humid, Bartlett 1 to 5 days longer, Howell 5 to 10 days longer, Clairgeau, Bosc, Anjou, Comice 10 to 30 days longer.

In Car Temperature Storage, Bartlett held 30 to 35 days, turning yellow in 16 to 18 days. Yellow Bartlett held 10 to 12 days in Cold Storage, but broke down rapidly after being removed from storage. Kenly Bosc held 55 to 75 days; 30 days before beginning to soften, Hollywood Bosc grown under dryer conditions held up longer. Howell kept 30 to 40 days before turning yellow; 60 to 90 days before being entirely gone; Anjou and Comice were in prime eating condition three and a half to four months after being put in storage.

Delayed Storage gave varying results. With Bartlett, Delayed Storage lots invariably held up longer than same lots in Car Temperature Storage. Little difference was observed between material in Delayed Storage and that put directly into Cold Dry Storage. With Bartlett, transferring from one storage temperature to a colder one seemed very definitely to check ripening. With later varieties, Delayed Storage invariably shortened the time fruit would keep as compared with immediate storage at the same temperature. Anjou, Comice, and Clairgeau when given Delayed Storage last about the same length of time as such fruit given Car Storage.

The comparative tests of the relative value of Cold Dry and Cold Humid Storage are not entirely satisfactory, owing to the fact that the temperature of the humid room averaged 3 to 4 degrees colder than the dry room. Results may be due either to the humidity or the temperature or possibly of a combination of both. Bartlett held 50 to 60 days in Dry Cold; 90 to 110 in Humid Cold. With later varieties, months after picking in either storage, Bosc, Anjou, Howell, Comice, and Clairgeau were in fine condition. With Bartlett all types of storage seemed to give very similar results as far as quality is concerned. Bartlett held too long in Humid Cold Storage were found to scald badly, but when removed before they reached the scalding stage, were of good quality. Anjou gave excellent results in all types of storage, time of picking rather than type of storage influencing quality.

No Bosc of good quality were secured where fruit was held under refrigeration, while those held at 70° ripened nicely and were of excellent quality, the flesh becoming mellow and full of juice. Under car temperature Bosc had a tendency to become mellow on the outside while the inside

remained hard and green, though some ripened sufficiently to become of fair quality. In Cold Storage no Bosc ripened well; the surface became soft and even decayed while the interior remained still hard and green, making the fruit absolutely worthless. Chemical tests show much less sugar in Bosc ripened in Cold Storage than those ripened at a temperature of 70°.

The investigation showed that Cold Storage of large quantities of Bosc is undesirable until a better way of handling them can be determined.

An attempt was made to see if a starch test could be used to indicate proper time of picking. It is feared that this test is too delicate to be depended upon. Further study may show some way of utilizing it to better advantage.

Specific gravity tests were used as a basis for determining maturity of fruit, but show nothing, at this time, of value to orchardists. Further investigations may show them to be of value.

Chemical analyses were made to determine the amount of sugar, acid, and moisture in Bartlett and Bosc from the time they were picked until they were removed from storage. No definite correlation could be established between time of picking, keeping quality, or eating quality, and the analysis for sugar, moisture, and acid. There is seemingly no regular gradation in the percentage of reducing sugars and sucrose in the green pear from early to late pickings. Small, poorly grown Bartlett and Bosc contained slightly more sugar than large well-grown specimens. Poorly grown Bartletts contained a very much higher acid content than well-grown ones. The chemical results are published in Table III.

PEAR RIPENING INVESTIGATIONS

The question of the exact time at which pears in the Rogue River Valley should be picked to secure the best results in quality, both eating and keeping, is one upon which considerable diversity of opinion exists. The exact influence of the time of picking upon the storage life of the fruit, upon the eating quality, and upon the size, and the relative importance of these considerations in determining the time of harvesting of the commercial crop are points that have never been fully determined.

It was for the purpose of throwing light upon these questions that an investigation was outlined by the Oregon Experiment Station. The work was so planned that the following questions might be answered:

1. What is the influence of time of picking upon keeping quality of the pear when stored under various conditions of temperature and humidity?
2. What is the influence of time of picking and type of storage upon eating quality of fruit?
3. What is the influence of time of picking upon size of fruit?

4. What correlation exists between time of picking, type of storage, and chemical composition of the fruit, so far as sugars, acid, and percentage of moisture are concerned?

5. Is it possible from a simple chemical or physical test, to determine the stage of development in the fruit at any time?

With these points in mind, the investigation was outlined as follows:

In choosing orchards from which to select fruit we kept in mind the importance of soil type and the relation of orchard practice to our problem; accordingly, orchards were chosen representing certain types of soil, and both non-irrigated and irrigated trees were selected.

Pears of all the principal varieties grown in the Rogue River Valley were used in the test, including Bartlett, Bosc, Howell, Anjou, Comice, and Claigean. Since the Bartlett and Bosc are the two most important varieties in the district, and since these questions are perhaps more acute in them than in any other variety, somewhat more work was conducted with them than with the other varieties under observation.

Fruit was taken from the following locations:

Bartlett—Bear Creek orchard—trees about 15 years of age. Heavy soil, under irrigation. Good crop on trees.

Hillcrest orchard—heavy soil, not irrigated. Trees 8 to 10 years old. Owing to very dry season trees had suffered greatly and fruit was small.

Fiero orchard—light, sandy, creek-bottom soil, slightly irrigated. Trees 8 to 9 years old, vigorous, and good crop.

Bosc—Kenly orchard—rather heavy soil, irrigated. Trees 9 to 11 years old, medium to light crop of large, well-grown pears.

Hollywood orchard—heavy soil not irrigated. Trees with very heavy crop of small pears, selected.

Comice—Hollywood orchard—heavy, non-irrigated soil. Trees large, 12 to 15 years of age. Crop light, fruit large.

Anjou—Klamath orchard—heavy irrigated soil. Trees vigorous, 10 to 12 years of age. Crop fairly heavy.

Howell—Holloway orchard—heavy irrigated soil. Trees old, about 25 years. Medium heavy crop.

Clairgeau—Bingham orchard—heavy irrigated soil. Trees large, about 25 years old. Very heavy crop.

METHODS OF PROCEDURE

A sufficient number of trees was selected in each orchard to supply the amount of fruit that it was thought would be required for the complete test. These trees were then marked and the fruit was entirely picked by those having the work in charge. First pickings of each variety were made at the time of, or slightly in advance of, the first commercial pickings for that variety in the Valley. About three boxes of pears were removed with each picking.

In taking the fruit from the trees, care was taken to remove all the pears from certain limbs, while from those limbs which remained no fruit at all was removed. Fruit was taken from each side, and from top and bottom branches at each picking, so it was felt that each lot was really representative of the fruit on those trees at the time it was taken. Pickings from the same trees were made at intervals of four to five days throughout the season.

The fruit was immediately taken into a packing house, and packed out in half boxes, six lots being packed out for storage. From 45 to 60 pears of each lot were put into each type of storage used. In addition to that stored, average samples of each lot were taken to determine starch content, juice specific gravity, and for chemical analysis for sugars, acid, and moisture.

STORAGE USED

Fruit was stored under six different conditions, as follows:

1. **Common Storage.** The basement of the Medford Fruit Company building was used for this test. Temperatures were very equitable, ranging from 66° to 73° during August, 60° to 70° during September, and from 45° to 60° during October and November. There were no sharp fluctuations, the difference between the temperatures throughout the course of the day being not more than 4° to 8° on the average. The normal humidity in this storage was not altered, and ran from 40 to 70 percent saturation.

2. **Common Humid Storage.** This type of storage was also secured in the basement of the Medford Fruit Company building, a vault opening off the room used in common dry storage being used. Temperatures averaged almost exactly the same as above, though the fluctuations in temperature were considerably less.

In this room, the relative humidity was raised by blowing air between strips of burlap, the lower edges of which were immersed in water. An electric fan was used to secure the necessary circulation. By this means, it was possible to raise the relative humidity to an average of 90°.

One factor which entered into storage in this room was the fact that there was practically no change of air in the room. In a comparatively short time, however, the air probably became quite heavily charged with carbon dioxide. While no analysis was made, the foulness of the air was very noticeable upon entering the room.

3. **Car Temperature Storage.** This storage was in a small room in the Ashland Ice Plant, kept fairly cool by surrounding ice storage, though there was no direct refrigeration. Temperatures in this room ranged from 50° to 62° during the early part of the season, gradually lowering as outside temperature became lower.

Due to the moisture from melting ice all around, the humidity was rather high, averaging 60 to 75 percent. Temperature and humidity were fairly constant, and aeration was good.

4. **Cold Dry Storage.** This fruit was put in a regular ammonia-cooled storage room in the Ashland Ice Plant, and held at a temperature of 36° to 38°. Normal humidity prevailed, the same running from 60 to 75 percent, because of low temperature.

5. **Delayed Storage.** Fruit to be handled in this way was picked and packed in the usual manner, then held for four or five days, or until the next picking of the same variety, in the packing room, under temperatures closely approximating outside temperature. Then it was transferred to the Cold Dry Storage room.

6. **Cold Humid Storage.** Another storage room was equipped as the Common Humid Storage for raising humidity. Because of the fact that the ammonia pipes condensed much of the moisture, it was possible to hold the room up to only about 80 to 85 percent saturation. The temperature in this room stood at about 32° F.

Fruit was picked during the course of the day, packed out, and always placed in the different types of storage the same day. Starch tests and specific gravity tests of the juice were run for each lot on the same day they were picked.

INFLUENCE OF TIME OF PICKING UPON SIZE

A careful check was kept throughout the season upon the average size of the fruit removed from each lot at each picking. Since individual branches were entirely cleaned off each time any fruit was removed, it was thought that each lot was a fair representation of what the crop as a whole was at the time. In each of the three Bartlett plots, moreover, one tree was left without removing any fruit until the end of the season, to see if the increase in size of the fruit was due to thinning the trees from which the fruit was removed, or to growth of the fruit regardless of whether or not thinning occurred.

The average size of the fruit in each lot for the different varieties is shown in Table I, which gives the number of pears of each lot required to pack a standard pear box. The letters a, b, c, d, e, and f merely give the different storages that the fruit went into, in order to secure an average, rather than depend upon the size put into any one type of storage.

The fruit was placed in the following types of storage:

- (a) Common Dry or Ventilated.
- (b) Common Humid Storage.
- (c) Car Temperature Storage.
- (d) Cold Dry Storage.
- (e) Delayed Storage.
- (f) Cold Humid Storage.

Table I. SIZE OF FRUIT.

BEAR CREEK BARTLETTS						
Lot No. 1	a-180	b-180	c-198	d-180	e-198	f-180
Lot No. 2	180	180	180	162	180	180
Lot No. 3	165	180	165	185	165	165
Lot No. 4	150	165	150	135	150	150
Lot No. 5	135	150	135	135	135	135
Lot No. 6	135	120	120	120	120	120
HILLCREST BARTLETTS						
Lot No. 1	a-234	b-216	c-234	d-234	e-234	f-216
Lot No. 2	210	228	210	210	234	198
Lot No. 3	210	210	210	210	210	210
Lot No. 4	192	198	192	210	234	210
Lot No. 5	198	180	198	198	198	198
Lot No. 6	198	198	180	180		198
PIERO BARTLETTS						
Lot No. 1	a-180	b-180	c-198	d-180	e-210	f-180
Lot No. 2	180	180	198	180	210	180
Lot No. 3	165	165	180	135	180	180
Lot No. 4	135	135	135	125	135	120
Lot No. 5	120	120	120	125	135	135
Lot No. 6			125			125
BINGHAM CLAIRGEAU						
Lot No. 1	a-198	b-180	c-165	d-165	e-150	f-180
Lot No. 2	180	165	165	165	165	150
Lot No. 3	135	150	150	150	150	165
Lot No. 4	135	135	135	135	135	135
Lot No. 5	120	135	135	135	150	135
Lot No. 6			112	125	125	113
HOLLOWAY HOWELLS						
Lot No. 1	a-165	b-165	c-165	d-180	e-168	f-
Lot No. 2	165	165	150	165	165	
Lot No. 3	150	150	150	150	150	
Lot No. 4	135	150	150	135	150	
Lot No. 5		135	135			
Lot No. 6						
KLAMATH ANJOU						
Lot No. 1			c-165	d-165	e-195	f-150
Lot No. 2			165	150	165	150
Lot No. 3			135	135	150	135
Lot No. 4			135	120		125
KENLY BOSC						
Lot No. 1			c-135	d-135	e-135	f-135
Lot No. 2			135	135	135	135
Lot No. 3			120	135	120	135
Lot No. 4			120	120		120

From a study of Table I, it will readily be seen that there was a great increase in the size of the pears in the course of the two or three weeks during which the fruit is usually picked. Since the first lots were picked at about the time of the first commercial picking, it is evident that if it is possible to leave the fruit on the trees even a short time longer than is the usual practice, a very great increase, both in total tonnage and size of pack, can be secured.

In order to determine if thinning the trees by removing part of fruit was necessary for the increase in size of the fruit remaining on the tree, fruit from trees from which no pears had been removed during the picking season was compared with that from trees from which most of the crop had been removed. Almost no difference in size could be detected. While a thinning of a heavily loaded tree will undoubtedly aid, to a cer-

tain extent, the "sizing up" of those fruits remaining, it is important to note that if the tree is not thinned, all the fruit will "size up" a good deal.

It is interesting to note that the Bartletts from the non-irrigated Hillcrest orchard did not increase in size nearly so much as those from orchards under irrigation, and consequently supplied with plenty of water. Trees in the Hillcrest orchard were suffering considerably for moisture, and this lack of moisture is reflected in the small increase in size of fruit on these trees.

INFLUENCE OF TIME OF PICKING UPON EATING QUALITY OF FRUIT

One of the most important considerations in maintaining the reputation of fruit products in market centers is always to send a product that will reach the market with the highest possible quality. With this in view, the harvesting of the pear crop at a time that will put it on the market with the best possible quality is extremely important.

The relation between time of picking and quality of the pears was very marked in most cases. With the Bear Creek and Hillcrest Bartletts, for example, the first lot picked in each case was much poorer in quality than the second and third lots. The fruit was astringent and puckery, while that of succeeding lots was much milder in flavor. This was not quite so pronounced in those from the Fiero orchard, as the first lot there was picked five days after the Bear Creek lot, but the same thing was true. The second lot in each case was also much poorer than the succeeding lots, though much better than the first. All lots from the third and fourth on were of excellent quality, and nearly uniform in flavor and texture.

With the later keeping varieties, the results were much more pronounced than with Bartletts. Howells of all lots ripened up well, and were of fair quality, though the later pickings were considerably better than the earlier. But with Clairgeau, Anjou, and Bosc, the first pickings were practically worthless because of their flat, insipid taste. While all the Bartletts were of fair quality, the first lots of these varieties were useless. There was improvement with each succeeding lot, but not until the fourth picking was made did the ripened pears reach the high quality found in these varieties under the best conditions.

The degree of perfection reached, varied greatly with the storage used, but this will be discussed under the subject of Storage.

INFLUENCE OF TIME OF PICKING UPON KEEPING QUALITY

The length of time that pears, after being picked, will hold up in good marketable condition, is of the greatest importance in a section where much of the fruit is sent onto the market in fresh condition. This is especially true of varieties like Bartlett, that ripen up very quickly. Careful study was made to determine if possible the best time for picking Bartletts to give them the longest season.

The first Bartletts picked were gathered August 16 and 18 respectively. These pears, placed in storage at 70° F., held up longer than any other pickings. Successive pickings tended to soften and rot in a shorter period of time, until those pickings made last held up only about half to two-thirds as long as those picked first. Exact times can be noted in Table II.

In other types of storage, however, there was a marked difference in results. With car temperature, cold, or cold humid storage, invariably somewhat later pickings held up longer than did the first ones. A study of Table II shows that while there is not the marked graduation found in the results from common storage, the third and fourth lots picked kept a little better than the others, while those gathered either before or after did not keep quite so long. Since this result was attained even with storage temperatures ranging from 50° to 60°, it would be expected that pears being shipped under ice would respond in about the same way.

The time of maximum keeping quality, however, is rather short, and the results of this one year's work indicate that the best keeping quality in Bartletts will be attained by leaving the fruit on the trees until slightly later than was practiced during this past year, then removing it as soon as possible.

INFLUENCE OF SIZE OF BARTLETT PEARS ON KEEPING QUALITY

Careful attention was devoted to the relative keeping characteristics of large and small fruit picked from the same trees at the same time. Practically no difference could be detected between them. Apparently there was little difference in degree of maturity at any time, as they ripened together and were decayed in the same length of time when under identical conditions. This is of especial importance in view of the fact that it is current practice to remove the larger fruits from the trees, leaving the smaller ones on for some days to "size up." In the light of the results of this investigation, it would seem to be best to leave all the crop on the trees until the best time to pick, then remove all of it, or at least as much as is going to be marketed as fresh fruit. Leaving the fruit on to "size up" for a week or two will probably mean that it is past its optimum condition for keeping.

In case of some or all of the crop being marketed through the canneries, etc., however, a great increase in tonnage can be gained by leaving the fruit on the trees until it has reached its fullest development.

With the other types of fruit under test, exactly the same results were obtained as with Bartlett, though the question as to proper time of picking is not so acute with them, due to the fact that there is ample time to get all of them to market before they become over ripe. As in the case of Bartlett, however, the first pickings of Bosc, Comice, Anjou, Clairgeau, and Howell all held up longest in 70° storage, both humid and dry. In the storages in which the fruit was held at lower tempera-

tures, however, pickings made later invariably held up fully as long or longer than did the earliest lots picked.

As a result of the data secured, it would seem that the tendency has been to pick the later varieties of pears too early. A study of the results recorded in the tables shows that a very marked increase in size can be secured by leaving pears on the trees somewhat longer, while the keeping quality for the storages used for these varieties is not lessened. At the same time, the best quality is obtained by leaving the fruit on the trees somewhat longer than is now the practice.

The only reason for early picking of these varieties is usually danger from wind storms, which may almost destroy a crop of nearly matured fruit. This is a very important consideration, but where the orchard is so located that it is more or less protected, the advantages of leaving the fruit on the trees until fully developed, are obvious.

INFLUENCE OF TYPE OF STORAGE UPON KEEPING AND EATING QUALITY OF PEARS

A careful comparison was made between the different types of storage used, to determine the relative value of each for pear storage. A study of the number of days that the fruit held up in different types of storage, as shown in Table II, will corroborate the following summary of the results secured:

All fruit ripened up very quickly in the 70° humid storage. Bartlett's were entirely gone in 12 to 25 days from the time they were put in. Bosc and Howell, varieties that usually hold up much longer, were gone within twenty-five days. Comice and Anjou ripened and decayed in about the same time.

As was mentioned in the description of the storage rooms used, there was practically no ventilation in the room; so it is impossible to say definitely whether the temperature and high humidity were mainly responsible for the very rapid ripening of the fruit, or whether the accumulation of carbon dioxide and other gases, due to poor ventilation, was the cause.

Fruit in the 70° dry storage, which was well ventilated, held up much longer than did that under humid storage at the same temperature. With Bartlett, the different lots held 1 to 5 days longer, with Howell, 5 to 10 days longer, and with Clairgeau, Bosc, Anjou and Comice, 10 to 30 days longer. There seemed to be the same variation between different lots that occurred under humid storage conditions; i. e., lots that held up longest in one storage usually held up longest in the other, and vice versa. The responses in both these storages were somewhat different from those secured under colder temperatures.

Car Temperature Storage. It is especially interesting to note the length of time that fruit held up in this storage, for the conditions of temperature and humidity were not far from those obtaining in a refrigerator car under ice during warm weather.

Bartletts in this storage held up 30 to 35 days, with the exception of the earliest pickings. This, of course, does not mean that they were in marketable condition that long, but it was that length of time before they were entirely gone, to the extent of being unusable. Pears at this temperature held up 16 to 18 days before turning yellow, a condition that would seriously detract from their sale price on the market.

Pears in this condition—i. e., turning yellow—were transferred to the cold dry and cold humid storage rooms, and it was found that they could be held easily for periods of 10 to 12 days, and still be in good condition for using, though they would have to be handled very quickly when taken out of storage.

Kenly Bosc pears held up in car temperature storage 55 to 75 days. All lots held up at least 30 days before softening. Since 30 days is more than ample time to put them into any market in this country, it is apparent that the keeping quality is ample, if they are not held too long. Hollywood Bosc, grown under very dry conditions, held somewhat longer than those from the Kenly orchard.

Howells, held at car temperature, lasted 60 to 90 days before being entirely gone; 30 to 40 days elapsed before they began to show any signs of ripening or yellowing. Anjou and Comice were in prime eating condition $3\frac{1}{2}$ to 4 months after being put in storages. The earlier pickings came on somewhat earlier than those in the later lots.

Delayed storage in which the fruit was held at packing-house temperatures for 4 to 5 days, then stored in the cold dry room, gave rather varying results. With Bartlett, delayed storage lots invariably held up longer than the same lots in car temperature storage. There seemed little difference between delayed storage material, and that put directly into cold dry storage, in the number of days that it would hold up.

Why this should be so is rather hard to explain. With Bartletts, however, it was observed that transferring pears from one temperature storage to a colder temperature storage room seemed very definitely to check ripening for some time, and it seems possible that suddenly changing the fruit from warm to cold storage after the ripening processes are proceeding rapidly, checks these processes to such an extent that ripening is much slower than would be the case had the fruit been put in cold storage soon after being removed from the tree.

With later keeping varieties than Bartlett, however, delayed storage invariably shortened the time that the fruit would keep, as compared to immediate storage at the same temperature. In the case of Anjou, Comice, and Clairgeau, material given delayed storage lasted about the same length of time that the same lots under car temperature storage held up.

Cold Dry and Cold Humid Storage. As was brought out in the discussion on storage rooms, these two rooms do not show the value of humidity in cold storage directly. Due to the low temperature prevailing, there was not so much difference in humidity as was hoped for, and the

temperatures were not uniform in the two rooms, the humid room averaging 3° to 4° colder than the other storage.

With Bartlett, the difference in keeping was very marked. Lots that held 50 to 60 days in cold dry held 90 to 110 days in cold humid storage. In many cases, the cold humid storage held up fully twice as long as the cold dry. How much of this greatly increased storage life was due to the humidity and how much was due to the lower temperature prevailing will need to be established by subsequent experiments. Of the later winter varieties, Bosc, Anjou, Howell, Comice, and Clairgeau, practically none of the lots had reached the end of their storage life at the time the work was discontinued four months after picking the fruit. The first lots of most of the varieties were soft enough to be prime eating, while the later pickings were still hard and green. Some of the cold dry lots showed a considerable amount of scald after three to four months in storage.

QUALITY OF FRUIT AS RELATED TO STORAGE

The relation of the type of storage to the quality of the fruit when ripened up presents a very interesting study. The variety question seems to be the largest factor involved.

In the case of Bartlett, all storages seemed to give very similar results so far as quality of the product is concerned. Bartlett left in cold humid storage scalded rather than ripened, and of course the result was practically worthless pears; but specimens taken some time before they reached the scalding stage ripened up normally and were of excellent quality.

Anjou also gave excellent results in all type of storage, the time of picking seeming to be the determining factor in quality rather than the type of storage used. The same was true of Howell and Comice. But with Bosc, there was the closest correlation between storage and quality.

In the work carried on, no high quality Bosc were secured from any lots that were held under refrigeration. Even the car-temperature lots did not ripen up with good quality. Pears held in the 70° storage ripened up in good shape, and those of the lots picked late in the season had fine quality. The flesh was mellow and juicy throughout. With those in car temperature, however, there was a tendency for the outside to become mellow, while the inside was still hard and green. Some pears in these lots ripened sufficiently, however, to be of fair quality.

In the Bosc lots in cold storage, there were no pears that ripened up at all thoroughly. The outsides of the pears would soften while inside the fruit was hard and green, being absolutely useless for eating. The surface would become soft and decay before the interior of the fruit became fit to eat. As a result, the cold storage Bosc were worthless.

Results obtained in commercial holdings of Bosc pears in storage are very similar to those secured in this investigation. Very seldom do they ever mature in good shape. The reason for this cannot be given at the present time, though some possibilities can be suggested.

As appears in the table showing sugar content, Table III, there is on the average considerably less sugar present in Bosc pears that have been ripened in cold storage than is present in those of the same lot ripened under 70° temperatures. It is possible that the low temperatures so retard the physiological changes associated with ripening—i. e., the changes of starches, sugars, etc.—that these changes are not accomplished before the physical structure of the fruit has broken down.

Whatever the causes may be, it is certain that the cold storage of large quantities of Bosc pears is not to be advised until some better way of handling the stored product can be devised. They can be utilized as a fall pear, but cold storage will have to be used rather carefully.

STARCH AND SPECIFIC GRAVITY TESTS IN RELATION TO TIME OF PICKING AND STORAGE

One object in conducting this investigation was to determine, if possible, some test by which the maturity of the fruit could be determined. and by which the fruit could be tested to determine when it is in proper condition for picking. One of the phenomena of the maturing and ripening of the fruit of pears and apples is the changing of starch into sugars. The hard, green fruit always contains a large amount of starch deposited in the cells of almost all parts of the fruit. As the fruit matures, this starch is converted into sugar.

It was thought that a test of the amount of starch present in the fruit at any time might be a means of determining its condition relative to whether or not it is ready to pick. Consequently, starch tests were made on a number of fruits of each lot, to determine this point.

Tests were made by cutting a thin cross section from the center of the pear, making the section to be tested as thin as could be cut conveniently. This was then immersed for a few moments in a 20 to 30 percent alcohol solution, containing $\frac{1}{2}$ percent iodine, and $1\frac{1}{2}$ percent potassium iodide. The alcohol solution was used to make the reagent penetrate and color more quickly. The same results can be obtained without the use of alcohol, but the test is much slower.

The iodine, coming in contact with the starch grains in the fruit tissue, colors them blue to purple, and from the distribution of color on the section, the relative distribution and amount of starch can be determined.

The green fruit, tested before it begins to ripen, shows a uniform dark color over the whole surface when cut in cross section, indicating an abundance of starch throughout the whole fruit. As the fruit ripens, the starch begins to disappear first in spots about the vascular or cambial ring, the spots being about the vascular strands. As the ripening process continues, these spots become enlarged until a complete ring appears, in which practically all the starch has disappeared. Then as the fruit continues to ripen, this section in which the starch is out enlarges mainly in the region inside the cambial ring, though somewhat each way, until there is only a trace of starch in the carpellary tissue about the seeds, and in a narrow ring about the outside, next to the surface of the fruit. This is

the condition in the fruit shortly before it is of prime eating quality when it is ripened in common storage. When the fruit is fully ripe and in prime eating condition, all the starch has disappeared.

It was found that considerable difference existed between different varieties, and within a variety between lots grown under different conditions as regards the amount of starch present at any time and the rapidity of its disappearance as ripening proceeds. Bartlett was studied more intently in this regard than any other variety, as the question as to the proper time of picking is perhaps more acute in this variety than any other.

Bartletts from a number of different orchards were tested from August 16 to 18, the time of the first commercial pickings. Practically all of the large size, well-grown pears, showed small regions about the vascular strands from which the starch was all gone. Some showed starch barely starting out, while others showed almost a complete ring about the cambial region. Pears from the non-irrigated Hillcrest orchard, suffering from lack of moisture, showed a solid starch region through the whole of the cross section.

As the season advanced, the starch on the average seemed to come out very little in the Bartlett. Samples taken ten days to two weeks later showed starch out in a complete ring about the cambial region in some pears tested while others showed almost no increase over what was out in those tested earlier. Even in pears picked 30 days after the first tests were made, starch was present throughout the whole fruit except in a ring about the cambial region. Bartletts grown under very dry conditions showed starch present throughout the whole testing season, in practically solid deposits throughout the fruit.

On the average, other varieties had a greater area from which the starch had disappeared than did the Bartlett. Howell showed distinct spots from which the starch was coming out in the first lots tested, August 17. By September 1, almost all specimens of Bosc, Anjou, Comice, and Clairgeau tested had a complete ring in which the starch had disappeared, and some much more than a complete ring. There appeared somewhat more uniformity in the results of starch tests with other varieties than with Bartlett, and it seemed that, on the average, the starch should be out somewhat more in other varieties when the fruit is in ideal picking condition.

The question arises, can the starch test be used as a basis for determining the season for picking pears, especially Bartletts? For this season, well-grown Bartlett pears, which, when viewed in cross section, had definite areas about the vascular bundles from which the starch was gone, apparently were ready to be picked. Some preliminary work, however, carried on during the 1916 season, indicated that for that season, considerable more starch should be gone to give maximum keeping quality. It will be necessary to continue this work through at least one or two more seasons before anything definite can be determined.

With other varieties, the starch test to determine time of picking seems less essential. Apparently everything is in favor of leaving the fruit on as long as possible, maximum size, quality, and keeping period being increased by late picking. With these varieties, the picking should be delayed as long as possible when danger of storms is considered.

SPECIFIC GRAVITY TESTS

Since insoluble starch is converted into soluble sugars during the ripening process, it was thought that the specific gravity of the juice would increase as the fruit ripened, because of a greater amount of sugar in solution. Consequently, specific gravity tests were made of the juice of all lots at the time of picking and of the ripe fruit from different types of storage.

The juice was extracted by grinding the fruit in a food chopper and pressing out the juice with a small hand press. Juice was tested at the temperature prevailing, and corrected to 60° F. by adding .001 for each 6° F. that the temperature was above 60°, or subtracting for temperatures that were below 60°. This figure was obtained by test. A study of the results obtained, as presented in Table II shows that there was a great deal of fluctuation in the tests obtained. The cause of these fluctuations was often hard to ascertain, but they may have been due to the fact that only about 5 to 7 pears were used to get the juice for each test.

From the data presented it will be seen that on the average there was a slight increase in the specific gravity in the green fruit, from the first to the last pickings. With all the varieties tested other than the Bartlett, there was on the average an increase in specific gravity in the ripened fruit over that present when the fruit was picked. With Bartlett, however, there seemed little difference. In some cases the ripened fruit showed even less specific gravity than the green lot. This may be easily due, however, to the fact that such small samples were used in extracting juice.

Both Bartlett and Bosc pears grown under very dry conditions, were very high in specific gravity as compared with the same varieties under ample moisture conditions. This can be seen by comparing Hillcrest and Fiero, or Bearcreek Bartletts, or Kenly and Hollywood Bosc, as shown in Table II.

CHEMICAL ANALYSIS OF PEARS

In order to determine as accurately as possible the changes that take place in the fruit during the ripening period, a series of analyses was run by the Chemistry department of the State Experiment Station. The fruit used was gathered and sent by express to the Experiment Station at Corvallis, arriving and being analyzed within about 24 hours of the time it was gathered. Analysis work was confined to Bartlett and Bosc mainly, one or two other varieties being run for comparison only. All lots of Bartletts from the Bear Creek and Hillcrest orchards were tested when picked, and again when ripe in common storage (70°); Bearcreek Bartletts were also tested when ripe in cold dry storage. Some of

the ripe-fruit analyses of Bartletts were not obtainable because the fruit arrived in too ripe a condition for analysis. Bosc pears, both from irrigated and non-irrigated trees were analyzed when first picked and when ripe in 70° humid storage, 70° dry storage, and in cold dry or car temperature.

The result of all analyses are given in Table III. Reducing sugars, sucrose, acid in terms of malic, and moisture were all determined on a percentage basis. A study of the data presented leads to the following conclusions:

There is no regular gradation, either of increase or of decrease in the percentage of reducing sugar in the green fruit from early to late picking season. Neither does any such gradation occur so far as sucrose is concerned.

On the average, small poorly grown fruit, both of Bartlett and Bosc, contain slightly more sugar than large well-grown fruit of the same variety. Bartlett on the average when picked green contains considerably more sugar than corresponding lots of Bosc. Lots of Bartlett on the average contain considerably more acid than do the Bosc. Poorly grown Bartletts have a very much higher acid content than well-grown ones, in some cases an amount almost double.

The amount of moisture in the fruit varies with the conditions under which it is grown. Small fruit under dry conditions runs several points under well-grown fruit in percent of moisture present.

As the fruit ripens, there is some variation in relative amount of reducing sugar and sucrose present, but there seems little definite gradation one way or the other. The number of analyses run was not sufficient to establish a definite correlation between ripening and sugar changes, if any such correlation occurs. On the average, however, there is a greater total sugar content in the ripened fruit than in the same lot at the time of picking.

There is little difference between the amount of moisture present in the green fruit and in the ripe. There is a slight increase in amount of acid present in the ripe fruit over that present in the green. This increase was fairly distinct.

No definite correlation could be established between time-of-picking, keeping quality, or eating quality, and the analyses for sugar, acid, and moisture.

GENERAL RECOMMENDATIONS FOR ORCHARD PRACTICE

The results obtained from the work carried on indicate that there are a number of changes that might profitably be made in harvesting operations. These suggestions are based on one year's work, and cannot be taken as absolutely final, but are well worthy of careful consideration and trial.

Picking Test. It was impossible to establish any definite test to determine time of picking. Testing for starch is an aid to the present orchard tests used, but cannot be depended upon when taken alone. The disappearance of a considerable quantity of starch seems to indicate that the

fruit is ready to pick, but much starch present does not necessarily indicate that the fruit is not ready. Starch must be used in conjunction with size, ease of picking, condition of seeds and flesh, and the various other tests now used in determining the proper condition of the fruit.

On the average, the earliest pickings of Bartletts were slightly too early for best keeping quality this past season. After the fruit reaches the condition of that picked first this season, several days more on the tree would improve size and both eating and keeping quality.

When the picking season is started, it is important that the entire crop of Bartletts that is to be shipped fresh be handled as rapidly as possible. From the standpoint of best keeping quality, there is no advantage in making two pickings. Late pickings, if shipped fresh, should be sent into markets as close as possible to the source of shipment.

If part of the crop is to be sent to a cannery, it is well to remove the large pears at the time of sending out the first shipments, then leave the others on the trees two to four weeks. They will gain greatly in size during such a period.

For varieties other than Bartlett, there is little danger of leaving the fruit on the trees too long except from the weather standpoint. A great increase in size can be gained by delaying picking beyond the time at which fruit is now removed, and this is important, not only because of increased total tonnage, but also because of higher prevailing prices for large-size fruit. A slight dropping of pears will usually be much more than overcome by the increased size of those remaining. Late pickings will also do a great deal toward insuring a high quality product on the market.

So far as storage is concerned, it may be said that with the exception of Bosc, the lower the temperature of the storage room, provided, of course, it is above the freezing temperature of the fruit, the longer the fruit will keep. In the case of Bosc, however, cold storage must be used very carefully if at all. Indeed, there is some question as to whether or not Bosc shipped under ventilation would not give much higher quality than Bosc under ice. Such a system of handling means placing Bosc on the market in the fall, rather than winter, but this may be the means of securing uniform good quality.

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TABLE II. INFLUENCE OF TIME OF PICKING AND TYPE OF STORAGE UPON KEEPING QUALITY OF PEARS

Lot No.	Date Picked	Starch test at time of picking	Sp. Gr. 60° F.	No. days before fruit was entirely decayed.				No. days held up after coming out storage.				Specific gravity of juice of ripe fruit.								
				70° Dry	70° Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid	70° Dry	70° Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid	
Bear Creek Bartletts																				
Bear Creek No. 1	8-16-17	Solid to coming out very slightly..	1.0475	25	23	25	55	39	83	26	0	8	6	12	1.055	1.052	1.049	1.046	1.050	1.052
Bear Creek No. 2	8-20-17	Considerable gone but not complete ring out	1.050	21	20	31	59	55	79	26	1	12	12	16	1.048	1.051	1.046	1.0525	1.050	1.0475
" " "	3 8-24-17	Almost complete ring out.....	1.054	19	18	32	55	42	112	26	2	9	8	11	1.053	1.046	1.048	.....	1.050	.....
" " "	4 8-28-17	Practically complete ring out—slightly more in some cases.....	1.051	15	15	35	67	47	108	27	2	8	9	12	1.0415	1.046	1.041	1.038	1.046	.....
" " "	5 9- 1-17	Not an entire ring clear spotted in Vascular Bundle	1.0495	15	13	31	63	55	104	27	3	9	12	12	1.056	1.048	1.048	1.052	1.053	.....
" " "	6 9- 6-17	Complete ring gone to just beginning to come out.....	1.0520	14	11	34	46	50	100	26	1	5	10	11	1.0535	1.0495	1.050	1.052	1.049	.....
" " "	7 9-11-17	Ring of starch not entirely gone in Vascular Bundle	1.045	16	11	29	41	53	94	25	2	8	8	9	1.052	1.052	1.055	1.059	1.054	.....
Hillcrest Bartletts																				
Hillcrest No. 1	8-18-17	Starch barely starting out in spots..	1.056	25	23	31	49	53	93	24	4	6	6	12	1.054	1.054	1.056	1.054	1.065	1.053
" " "	2 8-22-17	Starch solid to barely starting out....	1.0585	21	21	32	48	49	89	24	6	14	14	15	1.056	1.057	1.051	1.060	1.070	.....
" " "	3 8-27-17	Solid starch to complete ring out....	1.0585	19	17	36	56	52	109	24	5	11	11	12	1.056	1.053	1.0485	1.060	1.058	.....
" " "	4 8-31-17	Practically all show solid starch.....	1.065	20	15	36	56	60	105	25	4	12	12	12	1.071	1.060	1.066	.....	1.060	.....
" " "	5 9- 4-17	Solid starch	1.066	19	14	36	52	59	108	25	5	10	12	13	1.067	1.062	1.064	.....	1.057	.....
" " "	6 9- 8-17	Practically solid starch	1.0565	19	14	36	47	56	104	24	5	8	9	9	.....	1.061	1.051	1.061	1.055	.....
" " "	7 9-13-17	Practically solid	1.065	15	13	35	51	39	99	23	3	7	8	9	1.063	1.0635	1.059	1.054	1.063	.....
Flero Bartletts																				
" " No. 1	8-21-17	Coming out in spots.....	1.044	21	20	...	46	46	115	21	5	8	9	12	1.043	1.0455	1.053	1.053	1.048	.....
" " "	2 8-25-17	Complete ring of starch not quite out	1.0475	19	19	33	53	46	111	21	7	13	13	15	1.045	1.044	1.048	1.048	1.0495	.....
" " "	3 8-29-17	Almost complete ring out.....	1.0485	17	15	30	41	46	107	21	7	8	9	12	1.048	1.044	1.046	1.050	1.052	.....
" " "	4 9- 3-17	Out in large spots.....	1.046	15	12	37	66	57	102	21	7	7	8	9	1.0460	1.049	1.0495	1.059	1.047	.....
" " "	5 9- 7-17	More than complete ring out, to only small amount gone.....	1.0465	14	12	33	48	53	98	21	8	9	11	12	1.052	1.051	1.053	1.0455	1.044	.....
" " "	6 9-12-17	Out in Irregular spots.....	1.044	17	12	32	33	48	93	20	6	7	8	8	1.046	1.045	1.047	1.049	1.046	.....
" " "	7 9-17-17	Complete ring out to most gone.....	1.043	16	12	35	28	50	88	19	6	6	8	9	1.054	1.048	1.050	1.057	1.049	.....

TABLE II. (Continued) INFLUENCE OF TIME OF PICKING AND TYPE OF STORAGE UPON KEEPING QUALITY OF PEARS

Lot No.	Date Picked	Starch test at time of picking	Sp. Gr. 60° F.	No. days held up after coming out storage.																Sp. Gr. of Ripe Fruit			
				70° Dry	70° Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid	No. days in Storage	Car Temp.	Delayed Storage	Cold Dry	Cold Humid	70° Dry	70° Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid			
Howell	No. 1	8-24-17	Almost complete ring of starch out	1.0465	27	21	59	83	97	129	62	15	15	17	18	1.049	.....	1.0495	1.0525	1.0535	1.046	
	2	8-28-17	Out in spots throughout but not solid ring gone	1.048	28	17		94	98	**	63	9	9	11	13	.....	1.050	1.049	1.0515	1.0515	.....	
"	3	9- 1-17	Out in vascular bundles and in spots throughout	1.0475	25	16	70	94	94	**	63	7	7	11	21	1.051	1.050	1.048	1.0545	1.0505	.....	
"	4	9- 5-17	Varies, just starting to complete ring out	1.045	25	18	88	88	94	**	63	7	7	10	15	1.053	.....	1.0575	1.0535	1.0535	.....	
"	5	9-11-17	Out somewhat throughout but not all gone in any area	1.047	23	16	97	88	94	**	62	14	12	13	18	.....	1.057	.....	1.0535	1.0555	.....	
"	6	9-17-17	Coming out throughout hardly complete ring	1.056-	19	..	90	..	..	**	63	15	..	18	..	.....	1.055	1.053	.....	.....	.....
Clairgeau	No. 1	8-23-17	Entirely out in complete ring.....	1.041	56	41	81	107	88†	†	63	20	20	21	..	.....	1.046	1.0	.....	1.048	.....	
	2	8-27-17	Out two-thirds of way from center to outside—trace in core.....	1.040	54	37	..	104	103†	†	64	18	18	18	21	.....	1.045	1.045	.....	.....	.....
"	3	8-31-17	Almost entirely out to within ½" of outside	1.040	54	33	73	106	99†	†	64	12	22	15	21	.....	.....	.....	.....	.....	.....
"	4	9- 4-17	All out inside vascular ring except core—some more	1.044	51	29	89	102	95†	†	64	7	18	18	21	.....	.....	.....	.....	1.051	.....	
"	5	9- 8-17	Irregular ring out outside carpellary tissue	1.0405	53	25	100	98*	91†	†	65	12	16	18	..	1.047	.....	1.051	.....	.....	.....
"	6	9-13-17	Coming out in regions of Vas. ring...	1.041	50	21	98	93*	92†	†	93	19	20	20	21	1.038	1.055	.....	.....	.....	.....
"	7	9-20-17	Solid starch in ½" ring about outside and in spots inside of that.....	1.047	44	30	102	..	85†	†	59	..	31	29	..	1.050	1.0475	1.050	.....	.....	.....
Anjou	No. 1	8-28-17	Almost entirely out within Vas. ring—spotted outside	1.050	..	..	..	..	..	..	58	21	16	18	22	.....	1.0505	1.0465	1.052	1.066	1.047
"	2	9- 1-17	Varies from almost solid starch to complete ring out	1.052	..	..	..	..	..	..	59	20	16	16	16	.....	1.053	1.0495	1.060	1.055	1.052
"	3	9- 5-17	Spotted to complete ring out.....	1.049	..	..	..	..	..	..	59	19	12	19	25	.....	1.055	1.0465	1.056	1.056	1.050
"	4	9-11-17	Small complete ring out just outside carpees	1.0495	..	..	..	..	..	..	59	17	13	11	21	.....	1.056	1.0445	1.0565	1.056	1.056
"	5	9-15-17	Starch out in spots outside carp. tissue	1.053	..	..	..	..	..	..	58	22	14	24	26	.....	.....	1.0505	1.059	.....	1.055
"	6	9-24-17	Complete ring out and in spots throughout	1.059	..	..	..	..	..	..	52	20	19	25	23	.....	1.0575	1.0495	1.0555	.....	1.054

*Not ripe.

**Prime eating to solid Jan. 1, 1918.

†Scalded

‡Not ripe after four months. Trace of scald.

TABLE II. (Continued) INFLUENCE OF TIME OF PICKING AND TYPE OF STORAGE UPON KEEPING QUALITY OF PEARS

Lot No.	Date Picked	Starch test at time of picking	Sp. Gr. 60° F.	No. days before fruit was entirely decayed.				No. days held up after coming out storage.				Specific gravity of juice of ripe fruit.										
				70° Dry	70° Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid	70° Dry	70° Humid	Car Temp.	Delayed Storage	Cold Dry	Cold Humid			
Hollywood Comice																						
"	No. 1	8-29-17	Starch starting out about vascular bundles	1.0475	..	..	110	61	..	107	57	8	8	11	12	.....	1.052	1.0545	.....	1.051	1.053
"	"	2	9-3-17	Starch solid to barely starting out	1.046	120a	94	..	103	57	12	11	11	13	1.0515	1.0535	1.0515	1.050
"	"	3	9-7-17	Starch practically solid throughout	1.0455	..	..	(a)	93	98	57	7	7	9	11	.....	1.054	1.0545	1.050	1.0535	.....
"	"	4	9-12-17	Almost solid—coming out in ring slightly	1.0505	..	..	(a)	89	93	56	10	7	10	11	.....	1.054	1.050	1.0595	1.0485	.....
"	"	5	9-19-17	Almost solid ring of starch gone outside carp. tissue	1.054	..	..	(a)	82	87b (c)	54	8	4	5	13	.....	1.057	.....	1.062	1.0595	1.058
"	"	6	9-24-17	Starch mostly out over considerable part spotted	1.054	..	..	(a)	..	82b (c)	52	10	..	13	13	.....	1.059	1.062	.....	1.0585	1.0515
Kenly Bosc No. 1																						
"	"	"	2	9-4-17	Ring of starch completely outside carp. tissue	1.0485	46	21	..	(d) (f) (g)	56	..	16	21	22	1.055	1.049	.....	1.053	.....	.....
"	"	"	3	9-8-17	Out inside vascular ring except in core	1.050	39	21	64	(d) (k) (g)	56	3	16	16	24	.....	1.054	.....	.....	1.0475	1.049
"	"	"	4	9-13-17	Entirely out in ring outside carp. tissue	1.046	44	21	60	(d) (e) (g)	56	..	11	11	19	1.057	1.055	.....	1.057	1.056	1.052
"	"	"	5	9-20-17	Out in ring inside Vas. tissue	1.0505	41	22	55	(d) (e) (g)	55	11	14	14	18	1.048	.....	.....	1.0475	.....	1.054
"	"	"	5	9-20-17	Starch mainly in 1/3" ring about outside some throughout	1.051	35	20	71	(d) (e) (g)	53	13	13	16	19	.....	1.052	.....	1.056	.....	1.056
Hollywood Bosc																						
"	No. 1	9-3-17	Solid starch throughout	1.061	64	22	77	(h) (i) (j)	52	16	16	18	..	..	..	1.0680	1.062	.....	1.060	1.063	.....
"	"	2	9-7-17	Solid starch	1.0615	63	22	70	(h) (i) (j)	51	10	13	15	20	..	1.065	1.065	.....	1.0585	1.060	.....
"	"	3	9-12-17	Solid starch	1.0615	52	19	72	(h) (i) (j)	52	12	13	13	21	..	1.046	1.064	.....	1.062	.....	.....
"	"	4	9-19-17	Solid starch	1.0695	55	21	89	(h) (i) (j)	49	15	15	15	17	..	1.066	.....	.....	1.064	.....	.....
"	"	5	9-24-17	Practically solid	1.072	60	28	84	(h) (i) (j)	49	..	..	..	..	..	1.063	1.0645	.....	1.066	1.0625	.....
"	"	6	9-28-17	Out in small spots	1.064	..	23	80	(h) (i) (j)	..	..	..	..	..	..	1.059	.....	.....	.....	.....	.....

(a) Prime eating, 80-90 days.

(b) Prime eating at this time.

(c) Prime eating, 90-100 days.

(d) By Dec. 17, 1917 all leathery, shriveled, soft rot, and scalded, none good.

(e) Not ripe, no scald in 90-100 days.

(f) Not ripe 90-100 days but 100% scald.

(g) Not ripe after four months.

(h) Shriveled, not mellow, scalded after three months.

(i) Shriveled and scalded after three or four months.

(j) Not ripe, no scald after four months.

(k) Not ripe 90-100 days. 95% scald.

TABLE III. CHEMICAL ANALYSIS OF PEARS

Lot No.	GREEN-FRESH PICKED					70° HUMID STORAGE					70° DRY STORAGE					DRY COLD STORAGE				
	Reducing Sugars	Sucrose	Total Sugars	Acid	Moisture	Reducing Sugars	Sucrose	Total Sugars	Acid	Moisture	Reducing Sugars	Sucrose	Total Sugars	Acid	Moisture	Reducing Sugars	Sucrose	Total Sugars	Acid	Moisture
Bear Creek Bartletts																				
No. 1	4.18	2.60	6.78	0.30	84.5	5.18	1.74	6.92	0.31	85.3	....	....	....	....	....	6.72	1.23	7.95	0.56	82.3
" 2	6.20	2.72	8.92	0.32	84.9	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" 3	7.01	....	....	0.25	84.2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" 4	6.63	2.50	9.18	0.33	84.3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" 5	6.84	2.65	9.49	0.29	80.3	7.26	1.60	8.86	0.37	84.8	....	....	....	....	....	6.54	1.90	8.44	0.31	84.0
" 6	5.75	2.21	7.96	0.33	85.5	....	....	....	....	....	....	....	....	....	....	7.07	2.28	9.35	0.36	83.7
" 7	6.78	1.79	8.57	0.27	84.8	7.02	2.28	9.30	0.35	84.8	....	....	....	....	....	6.74	2.62	9.36	0.29	84.5
Hillcrest Bartletts																				
No. 1	6.56	2.72	9.28	0.47	80.9	8.33	3.08	11.41	0.58	80.4	....	....	....	....	....	6.42	1.00	7.43	0.48	84.3
" 2	6.72	2.86	9.58	0.42	81.9	8.56	1.96	10.52	0.57	81.0	....	....	....	....	....	....	....	....	....	....
" 3	7.23	3.33	10.56	0.56	80.9	8.51	1.75	10.26	0.60	80.1	....	....	....	....	....	....	....	....	....	....
" 4	7.49	3.18	10.67	0.49	80.7	7.83	2.12	9.95	0.56	80.6	....	....	....	....	....	....	....	....	....	....
" 5	7.23	1.38	8.61	0.46	81.2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
" 6	7.50	1.00	8.50	0.47	81.4	8.54	2.40	10.94	0.56	80.5	....	....	....	....	....	....	....	....	....	....
" 7	7.60	1.96	9.55	0.47	80.2	8.04	3.78	11.82	0.48	80.2	....	....	....	....	....	....	....	....	....	....
Kenly Bosc																DRY COLD STORAGE				
No. 1	5.40	0.53	5.93	0.24	85.05	7.66	0.57	8.23	0.26	85.3	6.68	0.99	7.67	0.24	84.30	6.98	1.66	8.64	0.25	84.0
" 2	5.42	2.68	8.10	0.26	84.60	7.92	1.67	9.59	0.27	84.4	6.50	1.22	7.72	0.19	84.50	7.12	2.70	9.92	0.25	82.8
" 3	5.76	1.69	7.45	0.25	84.35	6.87	2.07	8.94	0.30	85.2	7.15	1.80	8.95	0.24	83.20	6.68	3.12	9.80	0.21	83.9
" 4	4.88	2.41	7.29	0.21	84.70	6.68	3.06	9.74	0.22	85.0	6.73	1.19	7.92	0.17	83.60	....	....	....	....	....
" 5	5.00	2.75	7.75	0.22	83.90	6.68	3.22	9.90	0.26	84.4	7.30	0.98	8.28	0.14	83.60	....	....	....	....	....
Hollywood Bosc																CAR TEMPERATURE				
No. 1	6.08	....	....	0.23	80.5	6.84	3.80	10.64	0.23	80.2	6.33	3.21	9.54	0.27	79.50	6.75	3.72	10.47	0.23	77.2
" 2	4.95	1.97	6.92	0.20	80.3	6.14	4.50	10.64	0.29	80.6	5.76	3.86	9.62	0.23	79.20	6.61	4.07	10.68	0.33	77.8
" 3	4.55	3.41	7.98	0.20	79.8	6.93	4.75	11.68	0.29	79.2	5.68	4.20	9.88	0.20	79.10	6.80	5.51	12.31	0.22	76.1
" 4	4.33	4.21	8.54	0.16	78.2	5.57	5.80	11.27	0.27	80.0	5.73	4.22	9.95	0.15	78.30	6.35	6.15	12.50	0.21	75.9
" 5	....	....	....	....	....	....	....	....	....	....	5.81	5.14	10.95	0.16	77.50	6.72	8.00	14.72	0.21	76.2
" 6	....	....	....	....	....	....	....	....	....	....	5.82	5.65	11.47	0.17	76.80	....	....	....	....	....