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An Inquiry Into the Nature of a Somatic Segregation of Characters in the LeConte Pear

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Foreword

No subject before the scientific world today is receiving more attention than that of inheritance of characters. Intimately associated with the question of inheritance is that of the expression or development of inherited characters. Any addition to our body of knowledge on this subject probably hastens the day when we shall have a much more complete understanding of the methods and processes of heredity and of their application to practical breeding problems.

It is believed that this article by Mr. Warren P. Tufts is a contribution to our present somewhat limited data on one particular phase of the subject; namely, bud-variation. The paper was recently presented to the Faculty of the Oregon Agricultural College as part fulfillment of their requirements for a Master's Degree in Agriculture.

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Chief, Division of Horticulture.

An Inquiry into the Nature of a Somatic Segregation of Characters in the Le Conte Pear.

INTRODUCTION

There are many examples of variation of characters in somatic tissue mentioned in horticultural literature, and probably only a few of those existing have as yet been observed and recorded.

Downing (1), in describing the May Duke cherry, mentions the fact that this variety frequently produces some branches which ripen their fruit much later than the others, thus conspicuously prolonging the fruiting season.

Coxe (2), in describing the sweet and sour apple, remarks that this variety "derives its name from the peculiar property of possessing these different qualities in the same fruit; the surface is often uneven, the prominences having one taste and the hollows another."

That sometimes different parts of a plant are to be found bringing into expression different characteristics, is well illustrated by Bailey(3), who calls attention to the fact that very often a root cutting will not transmit variegations, although other varietal characteristics remain the same. For example, the variegated prickly comfrey does not always come true to type when propagated from root cuttings. When propagating some variegated plants, also, such as the ivy-leafed geranium L'Elegante, by means of leaf cuttings, variegations will not always be reproduced by the rooted leaf.

Webber (4), in describing a certain pineapple variety, the Red Spanish, calls attention to the fact that this variety sometimes has nearly smooth-margined leaves, but at other times the leaves are wholly or in part serrate, thus exhibiting a true somatic variation.

Instances in which color is the character which separates out are described by Kraus. (5). For example, the Esopus (Spitzenberg) apple, very frequently exhibits a pure yellow band of varying width extending from stem to calyx, although the Esopus is usually solid red in color. Other varieties behave in much the same manner from time to time; but no variety, so far as we have record, exhibits a striping in a color for which it bears no factor, as determined by breeding experiments. Hedrick (6). Kraus also mentions a certain almond tree which bears both sweet and bitter fruits, scattered throughout the tree.

Cook (7), in discussing the dimorphism occurring in the leaves of certain varieties of cotton and closely related plants, cites an additional example of variation of somatic tissue. "The Egyptian variety of *Hibiscus cannabinus*

with the lobed leaves produced entire leaves at the base of the stalk, as also happens with the narrow lobed 'okra' varieties of Upland cotton. The Hibiscus leaves show a very abrupt transition from the broad, simple form of leaves on the lower part of the stalk, to the narrow, deeply lobed form on the upper part."

Perhaps these random citations (no effort has been made to present a complete list) are sufficient to show that a variation of somatic characters is no new thing and that frequent mention of such facts may be found in horticultural literature. It would be very interesting if some study could be made in these cases in order to ascertain, if possible, the general laws underlying such variations.

Attention to the somatic variation of characters as it commonly occurs in the LeConte pear, was first drawn by V. R. Gardner, of the Horticultural department, of the Oregon Agricultural College, in February, 1913.

ORIGIN OF THE LECONTE.

The common pear, *Pyrus communis*, has been cultivated in America from the earliest colonial times and has been grown with more or less success in many parts of the country. There is another pear, *Pyrus sinensis*, whose first recorded appearance in the United States is to be found in the Nursery Lists of the Prince Nursery, Flushing, Long Island, in 1841, having been imported by that company from France.

The general botanical characters of the common pear, *Pyrus communis*, are well known. and it is needless to introduce a description of them at this point. However, the general characteristics of *Pyrus sinensis*, the Chinese or Sand pear, as it is commonly known, should receive brief mention.

Pyrus sinensis "attains a height of twenty or more feet and is remarkable for its vigorous and rapid growth of strong, thick greenish shoots, its freedom from disease, and its hardiness. The leaves are long-pointed and broadly ovate, dark green, shining, and larger than those of *Pyrus communis*, with margins that have sharp, almost bristle-like teeth. The flowers are large, white tinted with pink, and appear shortly before the foliage. The fruit is hard and generally rough, usually with a cavity about the stem; the flesh is warted, gritty, tough, and in flavor poor and insipid; and the *calyx nearly always falls before maturity*. The species is known in this country in a number of varieties, among which are Daimyo, Gold Dust, Hawaii, Siebold, Japanese Sand, Sha Lea (Chinese Sand), and others." [8].

"The first hybrid to appear in this country was the LeConte. About the year 1846, Major John LeConte, a resident of New York, had a number of fruit trees sent to his niece, Mrs. J. L. C. Hardin, of Liberty County, Georgia, from the nurseries of Thomas Hogg. Among other plants was a tree of the Sand Pear, which Mr. Hogg had obtained from Ferdinand Potter, a nurseryman of Providence, who in his turn had received it from the Prince Nurseries. Contrary to expectations, the fruit proved to be much better than the Sha Lea (Chinese Sand) pear, as known up to that time. The variety was given the name 'LeConte', but its male parentage will never be known. It has been said to be the Bartlett, but this statement lacks good authority. (The fact is that this variety, like other so-called hybrids, may not be a hybrid at all, but merely a sport or seedling variation. The species has a marked tendency towards variation, and it is not necessary, therefore, to suppose that the LeConte is a result of hybridizing.)" [9].

PRESENTATION OF DATA.

With the foregoing facts in mind regarding the history and characteristics of *Pyrus sinensis* and its supposed hybrid, the LeConte, attention may now be turned to the immediate problem at hand.

Referring to the description of *Pyrus sinensis*, it will be noted that fruits of this species nearly always lose their calyces before maturity. In the case of

the LeConte, however, mature fruits may be obtained in which all of the calyx lobes are persistent, others in which only four are persistent, still others in which only three, two or one are persistent; and in many cases the entire calyx is deciduous. There does not seem to be any definite arrangement in which these calyces are persistent; the missing lobes may be adjacent or they may be opposite. Again, it is not in the mature fruit alone that this characteristic is to be observed; it may be seen from the time the fruit is first set.

There is in the College Orchard at Corvallis, Oregon, a tree of the LeConte pear. It was decided to make a careful observation and count of all the fruits produced on this tree during a single season, in order to determine, if possible, just what is the nature of this seeming *segregation of characters* in somatic tissue. Accordingly, as soon as the tree bloomed, a careful examination of the flowers was made in order to determine if any segregation takes place at this time. There were no striking variations in the flowers and nothing was observed at this time to indicate that there was later to be a segregation of characters; however, within a week or ten days after the petals fell the characteristic shearing off of the calyces or calyx lobes was readily observed.

As soon as the "drop" began, a large canvas was spread under the tree and the fruits were collected and counted from time to time throughout the entire season. As Table I shows, there was a total of 5396 fruits collected during the season. The first column gives the date of the observation; the second column, headed 5P, lists those fruits having all calyx lobes persistent; the third, 4P, those fruits having four calyx lobes persistent and one deciduous; the fourth, 3P, those fruits having three calyx lobes persistent and two deciduous, etc., and the seventh, D, those fruits having all calyx lobes deciduous. Under each count will be found the percentage such number bears to the total number of fruits collected and tabulated under that date.

TABLE I.

Date.	5P	4P	3P	2P	1P	D	Total
May 22	106	7	20	27	25	612	797
Per cent.	.13	.01	.03	.03	.03	.77	
May 29	87	9	16	30	21	400	563
Per cent.	.16	.02	.03	.05	.04	.71	
June 9	189	23	44	52	55	1,028	1,391
Per cent.	.14	.02	.03	.04	.04	.76	
June 14	112	25	40	55	41	585	858
Per cent.	.13	.03	.04	.06	.04	.68	
June 25	104	13	30	32	29	450	658
Per cent.	.16	.02	.04	.05	.04	.68	
July 26	1	1	3	1	1	19	26
Per cent.	.04	.04	.12	.04	.04	.73	
October 25	174	38	47	92	66	686	1103
Per cent.	.16	.03	.04	.08	.07	.62	
Total	773	116	200	289	238	3,780	5,396
Per cent.	.14	.02	.04	.05	.04	.70	

At first inspection Table I seems to throw but little light on the question in hand. Before it may be correctly interpreted, attention must be turned for a moment to the morphology of pomaceous fruits.

Pomaceous fruits in general may be regarded as consisting of one to several drupe-like fruits, more or less intimately united with a fleshy torus, on or within which they are borne. In the pear, the fleshy torus surrounds these drupe-like fruits, or carpels, which in this case are five in number. This somatic flesh, however, is only affected indirectly by the fertilization of the ovules, such fertilization usually providing the necessary stimulus for the development of this torus. ([10]).

In the immediate problem, then, it is permissable to regard each separate carpel as a distinct unit with which is intimately associated a single calyx lobe. The following tabulation is obtained by reducing the figures presented in Table I, separating all the above-mentioned drupe-like fruits into two classes according to the deciduous or persistent character of the corresponding calyx lobes. For example, referring to Table I, column 8, it will be found that 797 *composite* fruits (if such an expression may be used) were examined on May 22, or in other words a total of 3985 *separate* fruits, as above defined. The method of obtaining these tabulations is relatively simple. For instance, under the heading of 3P (Table I) the mathematical factor 20 is multiplied by 3, giving 60 separate fruits having a single calyx lobe and this lobe persistent; also, multiplying this same mathematical factor by 2 (the number of calyx lobes which are deciduous from fruits listed in this column) gives 40 separate fruits having a single calyx lobe and this lobe deciduous. Table II gives a summary of these computations:

TABLE II.

Date	Total	Persistent	Deciduous	Ratio
May 22	3,985	697	3,288	4.7
May 29	2,815	600	2,215	3.7
June 9	6,955	1,328	5,627	4.2
June 14	4,290	931	3,359	3.6
June 25	3,290	755	2,535	3.4
July 26	130	21	109	5.2
October 25	5,515	1,413	4,102	2.9
Total	26,980	5,745	21,235	3.7

DISCUSSION OF DATA.

According to Mendel's Law of Inheritance, it is to be expected that as a *general* thing in the immediate cross of two parents, with two opposing factors, the dominant factor is the only one in evidence; e.g., in the present case the parent, *Pyrus communis*, carrying a factor for persistent calyx lobes may be designated as "P" and the other parent, *Pyrus sinensis*, carrying a factor for deciduous calyx lobes may be designated as "D", then the first cross pD, would, according to general experience, show all the calyx lobes deciduous, if, as the data tend to show, the deciduous factor is the dominant one. Crossing pD on pD the next generation (F_2) would afford, according to common experience, a population represented by the formula $p^2+2pD+D^2$. In other words, it would be expected that the ratio of P to D individuals would be found as 1 is

to 3, the individuals pD on account of the dominance of the deciduous factor *appearing* the same as though pure D.

From the foregoing data, however, it is evident that in this pear hybrid there is not a complete suppression of the recessive character in the first generation (F_1). On the other hand, there is to be found a somatic segregation of characters in the *Immediate Cross*, and this segregation numerically follows very closely the numbers that would be expected in the F_2 generation, according to the Mendelian Law of Inheritance of contrasted factors.

Thus far it has been assumed that the LeConte is a hybrid between the species *Pyrus sinensis* and *Pyrus communis*, one of which carries a *single* factor for calyx deciduousness and the other a *single* factor for calyx persistence. This is undoubtedly an assumption not entirely warranted by facts. A careful study of *Pyrus communis* shows that it, as well as *Pyrus sinensis*, sometimes exhibits a tendency towards shedding its calyx lobes as the fruit develops. The following list of varieties of pears (Table III) is described by J. Decaisne ([11]), all of which varieties are supposedly pure *Pyrus communis*, (since the list was largely made up before the introduction of *Pyrus sinensis* to the general public of Europe. The first importation of *Pyrus sinensis* into Europe, however, was made in the year 1820, according to the records of the Royal Horticultural Society of London)([12]). In this list the variety is given in the first column; if its calyx lobes are always found to be persistent (P), a check (+) is made in the second column; if the calyx lobes are sometimes persistent and sometimes deciduous, a check is made in the third column headed mixed (M); and if the deciduous character very rarely appears, such varieties are further marked with an asterisk (*).

TABLE III.
List

Variety.	P	M	Variety.	P	M
Abbe Mongein	+		Bachelier	+	
Abondance	+		Baratte	+	
Adam	+		Baronnede Mello*		+
Adele	+		Bassin	+	
Alencon	+		Bavey	+	
Alexandrine Douillard	+		Belle Alliance	+	
Althorpe Crassane	+		Belle Angevine	+	
Amadotte	+		Belle de Thouars	+	
Amanlis	+		Bellissime d'Hiver	+	
Ambrette d'Hiver	+		Bennert		+
Amboise*		+	Bequesne		+
Amire Roux	+		Bergamotte Rouge	+	
Amoselle		+	Bernard		+
Amoselle Panaches	+		Besi de Heric	+	
Anne	+		Beurre*	+	
Ange		+	Bishop's Thumb	+	
Angelique de Bordeaux	+		Blanquet A'Longue Quene	+	
Angleterre	+		Bon Chretien	+	
Angleterre d'Hiver	+		Bonne d'Eyce	+	
Angoisse	+		Bonne Jeanne	+	
Angora	+		Bonne Malinoise	+	
Arbre Courbe		+	Bonne de Soulers	+	
Archiduc Charles		+	Bordeaux		+
Arenberg		+	Bosc	+	
Argent	+		Bouchet	+	
Auch	+		Boutoc	+	
Audibert	+		Bretonnean		+
Augier	+		Briet		+
Auguste Jurie	+		Briffant		+
Aurate	+		Brignoles	+	
Aurora		+	Brindamour		+

TABLE III—Continued.

Variety	P	M	Variety	P	M
Bronzee	+		Marquise		+
Bugi	+		Marsaneix	+	
Bugiarda*		+	Martin Sec	+	
Cadet de Vaux		+	Martin Sire	+	
Cadette	+		Matou	+	
Calebasse	+		Mauny	+	
Carmelite	+		Mauxion		+
Carriere		+	Messire Jean		+
Casimir Royer (often)		+	Milan Blanc	+	
Cassante d'Hardenpont	+		Millot de Nancy		+
Catillac	+		Moire	+	
Catinka		+	Monchcallard	+	
Cent Couronnes	+		Monsiegneur Affre		+
Chair a'Dame	+		Monsiegneur des Hons	+	
Chaptal		+	Montgeron	+	
Charbonniere		+	Montigny	+	
Charneu	+		Morelle Blanche	+	
Chat Brule	+		Mouille Bouche	+	
Chaumontel*		+	Muscat Fleuri	+	
Chedeville	+		Muscat a Longue Quene	+	
Choisnard		+	Muscat Lallemand	+	
Clairgeau		+	Musette		+
Colmar	+		Nain Vert		+
Colmar d'Ete		+	Nantes	+	
Coloma	+		Napoleon	+	
Columbia	+		Naquette	+	
Comice		+	Nec-plus-Meuris		+
Comte de Flandre	+		Nonpareille	+	
Concombrine	+		Noveau Poiteau	+	
Conseiller de la Cour	+		Oignonet de Provence		+
Coq	+		Oeuf	+	
Cornemuse	+		Oeuf de Cygne	+	
Crassane	+		Oken d'Hiver	+	
Crottee	+		Orange d'Hiver		+
Cuisse Madame	+		Orange Musquee	+	
Culotte de Suisse	+		Orange Rouge	+	
Cure*		+	Orange Tulipee		+
Curtet	+		Orpheline d'Enghien		+
Dalbret	+		Parthenay	+	
Dame	+		Passe Colmar	+	
Defays	+		Passe-Tardive	+	
Delices d'Angers	+		Pastorle	+	
Desire Cornelis	+		Paul Thielens		+
Deux Soeurs	+		Payenche		+
Doux Tetes	+		Pater Noster	+	
Diel		+	Pentecote	+	
Dix	+		Perle	+	
Docteur Benit	+		Petit Muscat	+	
Donville	+		Petit-Oin	+	
Double-Fleur	+		Pie IX	+	
Double Philippe	+		Pioulier	+	
Doyen Dillen		+	Poiteau	+	
Doyenne	+		Pomme	+	
Doyenne Roux	+		Precoce	+	
Duchesse de Berry	+		Prevost	+	
Duchesse de Mars	+		Quessoy	+	
Duval	+		Quetelet	+	
Duvergnies		+	Rance	+	
Emile d'Heyst	+		Ravut	+	
Epargne	+		Reine des Precoces		+
Epine d'Ete	+		Romaine		+
Epine du Mas		+	Rousse Lench	+	
Epine Rose	+		Royale d'Hiver	+	
Esperen	+		Safran		+
Esperine	+		Sageret	+	
Eyewood	+		Saint Gall	+	
Madame	+		St. Germain	+	
Madame Elisa	+		St. Germain d'Ete	+	
Mai	+		St. Lezin	+	
Mansuette	+		St. Michel Archange	+	
Marie-Louise Delcourt	+		Saint-Ours	+	

TABLE III—Continued.

Variety	P	M	Variety	P	M
St. Roch	+	.....	Thouin	+	.....
Saint-Waast	+	.....	Tilloy	+	.....
Salviati	+	.....	Tongres	+	.....
Sanguine	+	.....	Tonneau	+	.....
Sanguinole	+	.....	Tougard	+	.....
Sans Pepins	+	.....	Triomphe de Jodoigne	+	.....
Sarrasin	+	.....	Truitte	+	.....
Seckle	.....	+	Theurlinckx	+	.....
Seringe	+	.....	Urbanistes	+	.....
Seutin	+	.....	Vallee	+	.....
Shobden Court	+	.....	Van Assche	.....	+
Sieulle	+	.....	Van Marum	.....	+
Silvange	+	.....	Van Mons Leon Leclerc	+	.....
Six	+	.....	Vermillon	+	.....
Soldat Laboureur	+	.....	Veterants	+	.....
Stuttgard	+	.....	Vicomte de Spoelberg*	.....	+
Sucree Jaune	.....	+	Vigne	+	.....
Sucree de Montlucon	.....	+	Virgouleuse	.....	+
Sucre Vert	+	.....	Willermoz	+	.....
Sucre de Provence	+	.....	William Prince	.....	+
Surpasse Meuris*	.....	+	Williams	+	.....
Suzette de Bavay	.....	+	Zephirin Gregoire	+	.....
Tardive de Toulouse	+	.....			
Theodore Vans Mons	+	.....	Total	190	60

In the list of 250 varieties given in Table III, 31% *sometimes* show a tendency towards deciduousness of calyx lobes. Here, then, is statistical evidence that at least some varieties of *Pyrus communis* carry a factor for deciduous calyx lobes, although this factor is generally recessive.

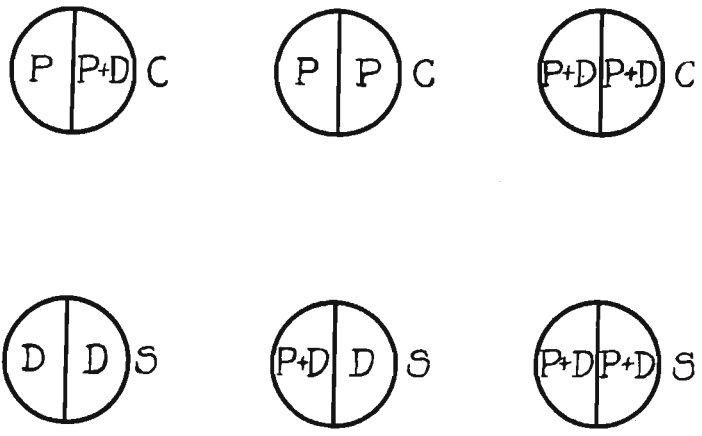
As will be seen from Table II, the ratio existing between the persistent calyx lobes and the deciduous lobes is not exactly 1 to 3, as it would be if the segregation of characters took place according to true Mendelian proportions, but is 1 to 3.7. The large number of observations made probably warrants the assumption that these data represent average conditions for the LeConte pear. The variance in this ratio from that of a strict Mendelian ratio is perhaps satisfactorily explained by the fact that *Pyrus communis* carries a factor for deciduous calyx lobes, as shown by the list of varieties of *Pyrus communis*, Table III.

Assuming that *Pyrus sinensis* carries *only* a single kind of factor and that factor for deciduous lobes, then the .7, which is above and beyond the precise ratio of 1 to 3, may be explained by saying that *Pyrus communis* produces one group of factors for calyx persistence only, and a second group of .832 factors for a calyx persistence and .168 factors for a calyx deciduous characteristic. Disregarding the list of varieties of *Pyrus communis*, (Table III) a second explanation of the same figures may be made, supposing that *Pyrus communis* carries *only* a single kind of factor and that factor for persistence of calyx lobes. Then the .7, which is above and beyond the precise ratio of 1 to 3, may be explained by saying that *Pyrus sinensis* produces one group of factors for deciduous calyx lobes only, and another group of factors carrying .168 factors for calyx deciduousness and .832 factors for a calyx persistence characteristic. A third hypothesis, equally possible, is that each group of factors of the supposed hybrid, LeConte, bears both deciduous and persistent factors; in this latter

case, however, it is evident that there is no way of determining the relative ratio between these characters.

The above assumption may be diagramatically represented as follows:

1st Hypothesis 2nd Hypothesis 3rd Hypothesis



In which:

C represents *Pyrus communis* "character".
S represents *Pyrus sinensis* "character".
P represents persistency factors.
D represents deciduous factors.

In connection with the foregoing, it is both interesting and instructive to examine the record presented by a few Transcendent crabs, a standard varicty of another pomaceous fruit which shows a similar somatic segregation of characters. Fifty-six fruits were examined and classified as follows, (Table IV) according to the number of persistent calyx lobes present.

TABLE IV.

5P	4P	3P	2P	1P	D	Total
7	3	3	7	4	32	56

Table IV presents data for the Transcendent crab similar to that presented in Table I for the LeConte pear. The figures given in Table V are obtained from Table IV in exactly the same manner that the figures in Table II are computed from the statistics given in Table I.

TABLE V.

Total	Persistent	Deciduous	Ratio
280	74	206	2.8

It will be seen from the data presented in Table V that in the case of the Transcendent crab, as well as in the case of the LeConte pear, there is a decided tendency for the deciduous character to segregate out according to Mendelian ratio.

The conclusion, stated above, is further strengthened by Cook ([13]), who in discussing the dimorphism of leaves which occurs in certain plants, gives a count of simple and lobed leaves occurring on a single plant of "Triumph" cotton. "Most of the leaves were simple and entire, only a few being three lobed and these with the lobes unusually short. A count showed 152 simple leaves and 41 with lobes." Although the counts are very few and not sufficient for complete accuracy, yet it is interesting to note that the ratio of lobed leaves to simple unlobed leaves is as 1 is to 3.7, seeming to have a general tendency to follow the Mendelian ratio. The fact that this may be a mere coincidence, however, removed by further counts, must not for a moment be overlooked.

GENERAL CONSIDERATIONS.

It would be very interesting as well as instructive if it could be determined definitely at just what period in the development of the plant this segregation takes place. In all probability it will be found to take place sometime during the development of the flower-bud or during the development of the latter into the young fruit. From an examination of the data, it is to be seen that this deciduous character is evident in the very young fruit and exists in about the same proportions as in the fruit which is fully matured. Fruits in which the various degrees of persistency of calyx lobes may be observed are to be found on the same fruit spur, as well as on different spurs.

Attention has already been called to the fact that the LeConte may possibly be a mere mutant or seed-sport rather than a true hybrid. Even if such is the case, this fact would not change the conclusions from the data here presented. It has been found that there is a segregation of characters in the somatic tissue of the LeConte pear and that such segregation tends to follow the Mendelian ratio whether the Le Conte is a hybrid or a mutant. It may be said, however, that since the Mendelian ratio is so closely approximated, it seems reasonable to consider the LeConte a true hybrid between the species *Pyrus communis* and *Pyrus sinensis*.

Even though it should be proved at some later date that the LeConte is a mere mutation of *Pyrus sinensis*, it is not unreasonable to suppose that this species carries a latent factor for persistence of calyx lobes. An explanation of the facts here recorded might then be based on a theory proposed by Cook that such phenomena are due to an alternate expression of characters, rather than to an alternate transmission as is usually proposed by followers of Mendel.

("The phenomena of inheritance have been supposed to center exclusively in the germ cells, the assumption being that all the characters that are shown in the adult are determined beforehand in the germ cells. . . .

"That the leaves and other vegetative parts of many plants do not have the power of regenerating or bringing the characters of other plants into expression, does not demonstrate a fundamental difference between germinal and somatic protoplasm. In some plants, such as the Begonia, it is evident that all of the tissues inherit all of the characters, since new plants are able to bud out freely from the leaf blades, petioles and stalks. . . .

"If there were a complete correspondence between the expression and transmission, so that the transmitted characters of a variety could be fully known from a single individual or from a generation of uniform individuals, the characters of a pure-bred uniform variety might be expected to remain fixed for all time and further selection would be entirely unnecessary as assumed in some theories. But in reality no such permanent uniformity has been found to exist. . . .

"The development of any individual plant may be viewed as a progressive change of expression of characters, the juvenile characters giving way to the adult, but the changes are usually so gradual as to suggest no analogy with the Mendelian form of definitely contrasted alternative inheritance. Abrupt changes from the juvenile to the adult forms of foliage have long been known in such cases as junipers and eucalyptus, but these have not been considered as of the same nature as the contrasted inheritance of Mendelian characters. In the case of the cotton and the Hibiscus, however, it appears that Mendelian relations exist in characters that are also subject to abrupt change during individual development. Mendelian inheritance is associated with other contrasted changes in expression of characters. The same characters that show contrasted expression in Mendelian hybrids may be as definitely contrasted, in related plants, in the growth of each individual. Mendelism, like the dimorphic differences, may be looked upon as representing alternative expression of characters instead of alternative transmission.") (14).

If this is a case of alternative expression rather than of alternative transmission of characters, the data presented would suggest that there is a mechanism possessed by the cell that enables it to bring into expression its several characters in as orderly a system and with as great a degree of certainty and precision as the mechanism possessed by the reproductive cells that provide for alternative transmission. Likewise, if the case in hand is to be interpreted as an instance of dominance and reversed dominance, the data show that there is apparently a mechanism possessed by the somatic cell capable of affording practically the same results and with the same degree of regularity as those afforded by the reduction and fertilization processes incident to bisexual reproduction.

It does not seem amiss at this point to call attention to the possible significance in practical breeding work of the fact of segregation of somatic characters. Segregation of characters cannot take place without the operation of some definite mechanism possessed by the somatic plant cell. If this mechanism is present it is reasonable to assume that *apparently* new valuable *combinations* of characters (improvement) may arise in the course of ordinary bud propagation, as well as in the case of sexual reproduction. The fact that such new combinations may mean retrogression, however, as well as progression must not for a moment be overlooked. It may be assumed that new characters cannot originate within the plant itself but must be added by crossing with an individual which posesses the characters to be added. On such an assumption, the new combinations may be explained by supposing that the characters within the plant-cell have been rearranged in an entirely different position; for example, they may be reversed (in dominance), inverted, etc., thus giving rise to *apparently* new characters. Again, somatic segregation may be regarded as acting as a sorting process; i.e., when certain segregations take place inhibitors of valuable characters are separated out and these valuable characteristics then come into expression.

At present little is known definitely as to strains existing within a variety, but from information at hand it seems that such is sometimes the case. Well-known instances of what perhaps may be termed strains existing within horticultural varieties are afforded by the Baldwin, Gravenstein, Rome Beauty, and Yellow Newtown apples, which produce fruits of entirely different shapes, sizes, and colors when grown under different local environments. There is not at hand sufficient evidence to afford a definite explanation of these facts;

but the conclusions based on the data presented in this paper may afford a possible explanation of them.

Improvement by bud selection may seem to be more promising, now that there is presented a possible explanation of the immediate causes of at least some bud variations. As more is learned about the horticultural strains that exist within vegetatively propagated varieties, greater care must be exercised in the reproduction of such plants, either to preserve the type in its entirety, or else bear constantly in mind an ideal to be attained and select with this ideal always in view. All this means that in plants propagated by buds, attention will have to be paid to the mother plants from which buds are secured, in order always to be sure that the type is remaining the same and that different strains are not arising, be they retrogressive or progressive.

ACKNOWLEDGMENTS.

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LITERATURE CITED.

(1) Downing, A. J. Fruits and Fruit Trees of America. p. 483. 1881.
(2) Coxe, Wm. Cultivation of Fruit Trees. No 133. p. 172. 1817.
(3) Bailey, L. H. Nursery Book. pp. 62, 72. 1906.
(4) Webber, H. J. New Citrus and Pineapple Productions of the Department of Agriculture, U. S. Dept. of Agr. Yearbook. p. 338. 1906.
(5) Kraus, E. J. Bud Variation in Relation to Fruit Markings. Biennial Crop Pest and Horticultural Report, Oregon Agr. Coll. Exp. Sta. 1911-1912. 1913.
(6) Hedrick, U. P. and Wellington, R. An Experiment in Breeding Apples. Bul. 350. N. Y. Agr. Exp. Sta. 1912.
(7) Cook, O. F. Dimorphic Leaves of Cotton and Allied Plants in Relation to Heredity. Bul. 221. U. S. Bur. of Plant Industry. p. 11. 1911.
(8) Cox, H. R. Oriental Pears and their Hybrids. Bul. 332. Cornell Univ. Agr. Exp. Sta. p. 446. 1913.
(9) ———. Ibid. p. 451.
(10) Kraus, E. J. The Pollination of Pomaceous Fruits. Research Bul. 1, Part 1. Oregon Agr. Coll. Exp. Sta. 1913.
(11) Decaisne, J. Le Jardin Fruitier du Museum. Vol. II, III, IV, V, VI. 1858.
(12) Anonymous. Transactions of the Royal Horticultural Society of London. Vol. VI, p. 396. 1826.
(13) Cook, O. F. Dimorphic Leaves of Cotton and Allied Plants in Relation to Heredity. Bul. 221. U. S. Bur. of Plant Industry. p. 18. 1911.
(14) ———. Ibid. pp. 8–11.

PLATE I.

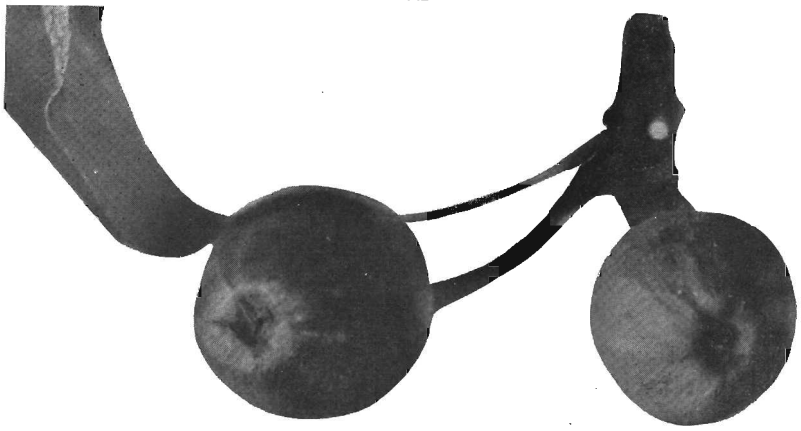

Fig. 1.—Two fruits of the LeConte pear, the calyces of which are entirely deciduous. Close scrutiny will reveal the lines where the calyx lobes have sheared off.

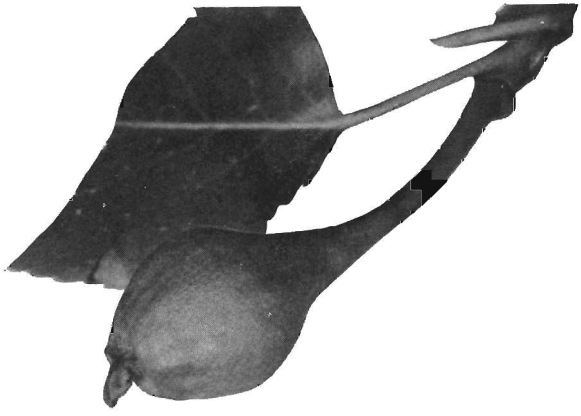

Fig. 2. A LeConte pear where all but one of the calyx lobes are deciduous.

Fig. 3. A LeConte pear with two calyx lobes persistent.

PLATE II.

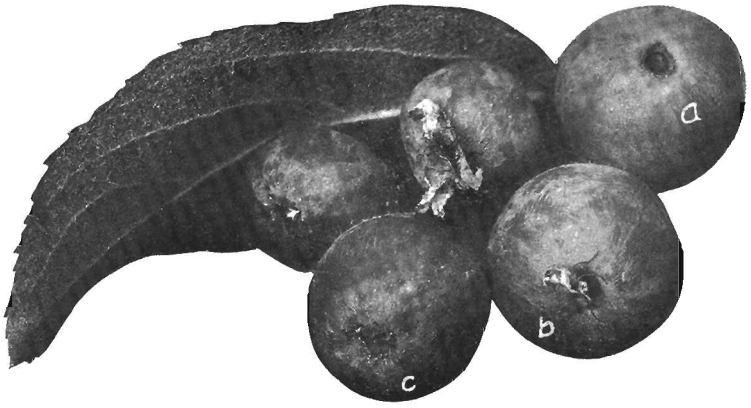

Fig. 4.—This figure shows a group of Transcendent crabs, two of which (a and c) show deciduous calyx lobes, one (b) with a single persistent calyx lobe, and the other two in the background with persistent calyces.

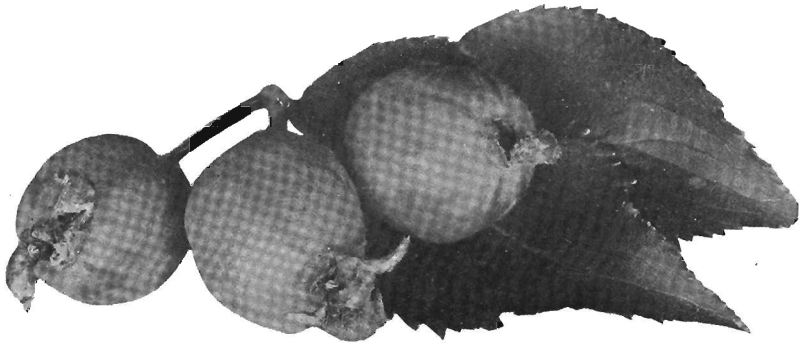

Fig. 5.—Another group of Transcendent crabs, the two fruits on the left having persistent calyces, and the one on the right having but one calyx lobe persistent.