

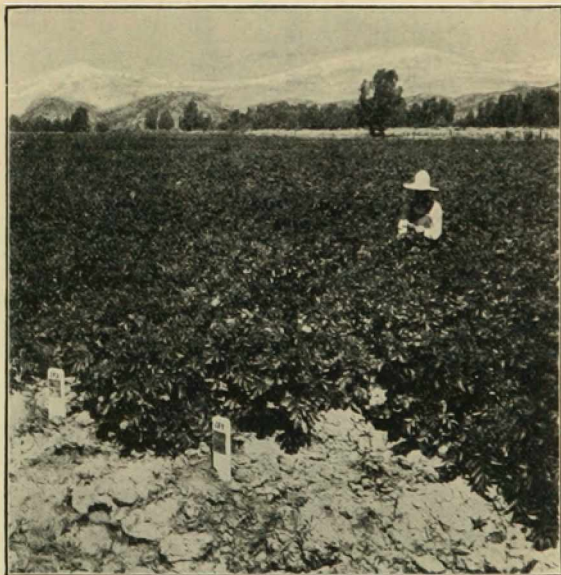
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Productiveness and Degeneracy of the
Irish Potato

Preliminary Studies Mostly Within the Pearl Variety



HYBRIDIZING

BY
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PLATE VI A FINE FIELD AT GREELEY.
An Intermediate Vine.



A PEARL TUBER: Part aerial, part underground.
A BLUE VICTOR "BASTARD" VINE: One plant
between No. 4 and No. 5. Blossoms but no seed
balls.

PRODUCTIVENESS AND DEGENERACY OF THE IRISH POTATO.*

Preliminary Studies mostly within the Pearl Variety.

By C. L. Fitch, Potato Specialist.

There is every reason to believe that principles true of one variety will be fundamental to all varieties of Irish potatoes. We submit these observations, however, in their bearing upon one variety only.

Cause of Tuber Degeneracy.—We find that within the Pearl variety, tubers become deep eyed, knotty, long and unproductive because of conditions that make the whole plant tend toward going to seed. Attention is called to the tendency of the tubers, which are enlarged stems, to be controlled in shape by the general habit of the plant. We also trace the branch and leaf habits which parallel tuber productiveness and degeneracy, giving drawings of the typical character of vines and corresponding photographs of tubers and using aerial tubers as proofs that certain tuber parts correspond to certain portions of other potato stems.

Sexual Tendencies.—We find the indicated factors of the tendency towards bearing seed to be early dryness, close and deep cultivation, and disease. We find that tuber productiveness in Pearls is in-

* The following is essential to the argument but not a part of it.

THE PEARL, PEOPLE'S, AND THE BLUE VICTOR, IDENTICAL EXCEPT IN COLOR.

The Pearl originated and still comes by bud variation from the Blue Victor. Of this family is the People's variety. All are alike in shape, excellent keeping quality of the tubers, quick sturdy growth, and medium time of ripening.

The vines and leaves, branching habit and tuber arrangement are alike in the three sorts, with the exception of the darker color of the whole Blue Victor plant, as might be expected from the tuber color.

The differences in the tubers of the three sorts consist in color and the character of the outer skin. The Blue Victor is of a purple color which, on exposure to the light, fades to a leaden brown, and is often streaked with white. This usually appears to be due to cracks in the skin, but sometimes appears to be the real outside color by variation, and when so covering an eye comes true in most cases both in the first propagation and in the succeeding crops of Pearls. The Pearl is brownish white with, at best, a well russeted skin, but there are often smooth spots on russeted Pearls, or whole crops that are nearly unrusseted. In the People's variety a deeper brown characterizes even the unrusseted skin of tubers, and both the russeted and the smooth skin appear to be thicker. On all the three sorts there are spots on occasional tubers, or more rarely whole tubers, which resemble and are identical with each of the others,—including blue spots or blue potatoes from both the Pearl and the People's. The color concentrated at the dormant sprout tips of the three sorts of tubers, at

versely proportionate to the sexual development of the plant; that the most degenerate tuber is grown by the plant which carries fully developed flowers and virile pollen; while those plants on which only the female portions of the flowers appear to be fully developed produce tubers intermediate in form and yield, and that the best tubers and the largest yield are produced by the type of plant whose buds do not even swell.

Practical Bearings.—The way is opened to study out:

1. What conditions insure productive seed potatoes.
2. How to grow potatoes free from defects.
3. What are the best changes of seed potatoes, and why.
4. How best, if way there be, to grow Pearl seed potatoes without change.

Additional light may be secured thereby on all problems of plant production where the seed is not the desired end.

occasional stem nodes, and which tints the underground part of the main stems, is alike in the three sorts,—deep in the Blue Victor, and faintly pink in the others.

We go minutely into the characteristics of these three sorts because it is essential to our reasoning that the varieties are **one**, with **three** sorts of color; while the corresponding degrees of tuber degeneracy occur in the three colors and therefore cannot be confounded with the chance introduction of tubers of other varieties.

Alike, among the three varieties, we find the same ideal types, the same average tubers, and the same degenerate forms. With tubers Nos. 4 and 5, Plate IV, there is a change to a lighter color—a phenomenon not yet understood. In the Blue Victor, the “bastard” form is lighter pink than the others; among Pearls, the bastards are whiter and more waxy in color, while in the People’s variety, the bastard forms, when placed beside Pearl bastards show the deeper brown shade that is a characteristic difference between the varieties.

The term **bastard** is one employed by growers and is herein used to mean a certain degenerate form of tuber of the Pearl family.

Environment of Plants Observed.—The writer has had experimental plots at elevations of 3500, 4000, 4500, 4800, 6500, 7000, 7800., and 8100 feet, and on soils ranging from light sand to clay loam, and with fertility varying from the limited nitrogen and humus content of lands never yet deeply moistened by nature and supporting only scant buffalo grass or scantier sage brush, to that of irrigated alfalfa lands perhaps unexcelled in natural fertility and nitrogen content. See Bulletin 175 of this station for a discussion of **The Potato Industry of Colorado**.

The Solution of a Leading Problem of one of the most highly specialized of farming communities is herein sought for the sake of that community and of the potato industry. The study is founded upon the previous work of the Station and is an out-growth of that spirit at Greeley which makes potatoes and the intricate problems of potato growing the leading topic wherever farmers get together, whether at the open meetings of the women’s country clubs, or when neighbors talk over the fence in the field.

Other Names: **Of the Pearl.**—Peerless, White Victor, Valley Prize, Mammoth White Pearl, and, in the opinion of Sutton & Sons, the Puritan, of Great Britain. **Of the Peoples.**—Polaris, People’s Party.

Future Development Work.—The way is pointed to explanations of the indicated superiority of seed potatoes grown under mulch and of those dug as in England before they are ripe. The promise of the future is that conditions favor the production in the Rocky Mountain region of the new varieties of the future, because on the arid irrigated plains the plants may be made sexual at will, be crossed, and then be developed under ideal irrigation conditions in our mountains. Improvement in varieties, which normally have a greater sexual de-



PLATE II. AN IDEAL HILL OF PEARLS.
Without Compound Eyes, Deep Eyes or Knots.

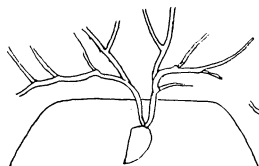
velopment than prolific Pearls, will doubtless be found in the selection of those plants and tubers which are the most completely asexual in habit.

AN OUTLINE OF THE OBSERVATIONS ON WHICH THE FOREGOING IS BASED.

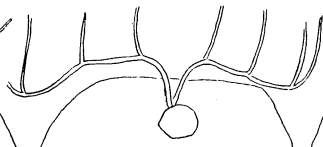
The Pearl Potato and the Pearl Seed Supply.—The Pearl is medium in time of maturity, and is better adapted to most regions of Colorado than any other sort. It is a great surface feeder and is adapted to soils made shallow by underlying moisture or gravel. It is a good keeper, and its vines are little subject to attacks by *Fusarium*,

PEARL VINE DEGENERACY.

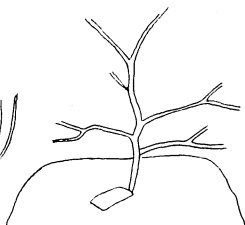
1.. Best Type



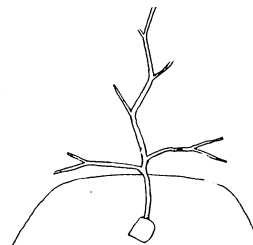
2. Common Type



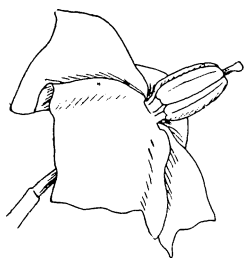
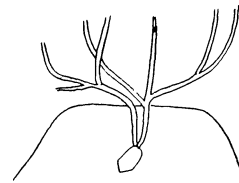
3. Intermediate



4. "Bastard"



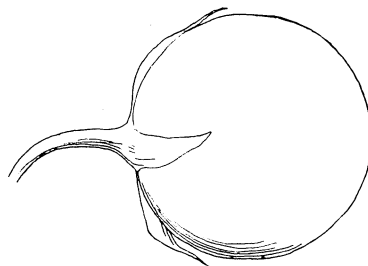
5. Seed-bearing Bastard



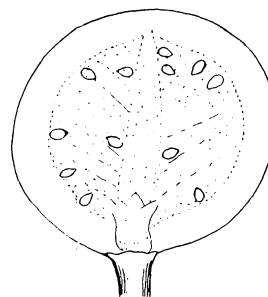
Perfect Flower



Fertilized Ovary



Seed Ball



Vertical Section



Seeds Magnified

PLATE III. PEARL BASTARD: SEED BEARING PARTS.

Drawings by Miriam A. Palmer.

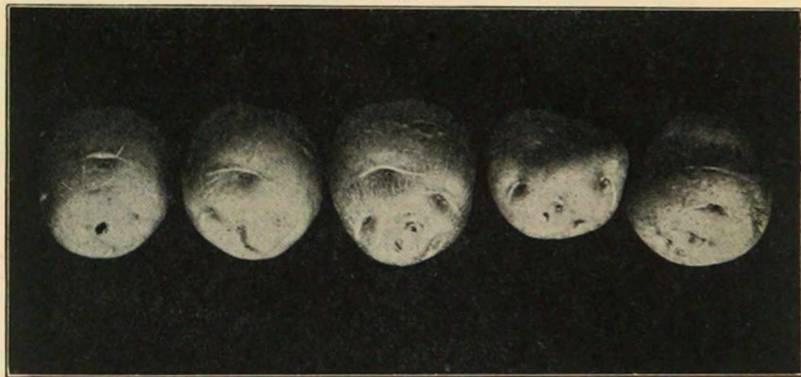
or its tuber to dry rot. The quality is excellent under good conditions.

Those regions which find Pearls their best variety are unable to maintain Pearl yield or shape, and are compelled to buy seed from other regions every year for raising the seed tubers to plant the large fields for the following year. Greeley also finds the Pearl variety subject to knots. In fact the most pressing economic need for the potato industry of Colorado is the increase and betterment of the Pearl seed supply.

Pearl Vines, Tubers and Blossoms.—The most productive Pearl vine (No. 1, Plate III.) stands, not erect in any of its parts, nor yet prostrate, and is typical of good conditions and good yields of tubers, free from knots and from deep or compound eyes. Where subjected to early drouth and close deep cultivation (No. 2) and then given abundant moisture, the main stems grow longer and interfere with the running of water as they become prostrate from the weight of "risers" which grow straight up from the nodes. The tubers produced by this common type of vine, while usually good, have deeper eye pits

PLATE IV. COMMERCIAL PEARL SEED.

1. 2. 3. 4. 5.



Good

Fair

Intermediate

Pearl Shaped
Bastard

Pear Shaped
Bastard

and more bulging eyes, and are subject to knots. About September 1st good fields of No. 2 look like alfalfa fields, the growth is so rank and the surface of the field so even. Such a field is shown in the photograph, behind the irrigator, with a single No. 3 vine in front of the coat. Plate VI., page 2.

This type (No. 3) marks the change from value to worthlessness. Fields that are rough and ragged over the top from the presence of No. 3 and No. 4 are undesirable as a source of seed. These vines are much alike, except that No. 3 divides the top. The blossom of No. 4 is more developed, and its tuber shows sudden and great degen-

eracy. Both No. 3 and No. 4 have been found only as single plants in the hill, which peculiarity may be attributed to strong tendency in the seed piece to grow single stalks and no side branches at the eye. No. 5 bears fertile pollen and large fruits with many vigorous seeds. It has more than one plant to the hill and loses the strong central character, but all the branches are erect, while the tuber becomes a pear shaped degenerate. There are of course forms intermediate between these types, but as a whole the steps are surprisingly distinct.

Pearl intermediates and bastards are found in the crop from the same seed which under better conditions produces only Nos. 1 and 2. For instance, a lot of Pearl seed, grading No. 2, from Del Norte, produced at Carbondale, in 1910, no intermediates or bastards, while the same lot of seed under the degenerating conditions of 1910 at Greeley produced many of both intermediates and bastards. We have found the same true with us time after time from seed sorted and restored, tuber by tuber by experts.

Sexual Tendencies Stronger than Selection in the Greeley district. The writer for four seasons, commencing with 1905, practiced near Greeley hill selection* of seed potatoes. In 1908 he selected from hand dug hills in the field a carload of seed Pearls and in 1906 a half carload. The tubers kept good in shape, even improved in outline, though the eyes were a little deep, and the reduced yields were ascribed to seasonal and other causes. The main stems became gradually stiffer. After the fall frosts the "first year" vines were prostrate, their leaves in the ditches, and the stems showed white as they lay on the hill, while the "pedigreed" vines had stiff upright center stalks which carried a brown flag of frosted leaves. The fields could thus be told apart to the row by their color as far as they could be seen. In 1909, on the same farm, because, it seems, the seed-bearing tendency had accumulated to override all other influences, the type and yield gave way to long cylindrical and irregular shapes with many bastards and seed balls. These Pearls in 1909 did very well at Pagosa and at Montrose and fairly well on the college plots, but, in 1910, from all these sources, on our various plots, and at Pagosa and Montrose, in private hands, showed their degeneracy of vine, tuber and yield. We have noted at Carbondale the gradual improvement of Pearls and other varieties long grown under ideal conditions, as compared with the type of Pearls more recently brought from places where they had approached the intermediate form.

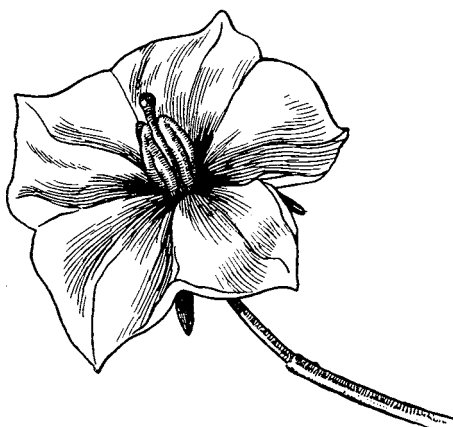
Blossoming of Pearls.—Neither the Blue Victor, the Pearl, nor the People's when at its best blossoms at all. The buds form early on relatively obscure stalks, but do not swell, do not show any color besides green, and soon blast and break off. This is true of vine No. 1, and to a large extent of vine No. 2, which last is characteristic of the Greeley district. Vine No. 2 will sometimes show color in the buds before they fall, and adverse conditions may produce late buds of this sort on No. 1; while severe dry early conditions will incline the habit of No. 2 in August strongly toward that of No. 3, and late bloom will be

*See this subject in Bulletin No. 175.

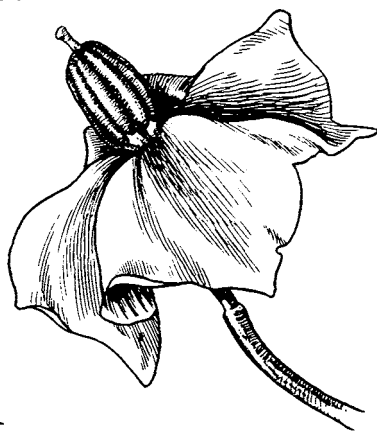
profuse. The blossoms of No. 3 are usually abundant, and while the female parts appear to be well developed the stamens are incompletely developed, and do not bear pollen. No. 4 is like No. 3, but with greater sexual development and a marked approach of the tuber toward that of No. 5, which bears abundant large seed-balls, with many and vigorous seeds.

PLATE V. PEARL BLOSSOMS.

Drawing by Miriam A. Palmer.



Intermediate Forms have a greenish yellow stamen, sometimes replaced by a hair, and always lacking in shape, color and pollen. No. 3 vine.



No. 5 Vine bears fertile blossoms with full corollas and orange colored stamens, with abundant virile pollen.

Conditions at Greeley.—The soil in this region, when well rotated with alfalfa, and especially when manured for a series of rotations, is exceedingly fertile, so that there are farms on which for years a yield of forty bushels of wheat per acre has been the minimum and where sixty bushels has been exceeded. As in most of the upper plains regions, there is a large element of adobe or gummy clay present in the major part of the soils of this district; and even when a part of sandy friable loams, this gummy ingredient is an adverse factor in the growing of potatoes, especially under irrigation on lands rather too flat* for water to run without puddling the sides of potato hills. Thus, with conditions favoring soil diseases of the potato, it has been proven by long experience at Greeley that on the average farm very close and very deep cultivation is the most profitable. The region and its people co-operate well and this system when once worked out has been applied to all lands alike, even where greater slope and more open soil make so rigid a system less desirable.

*See in Bulletin 175, *Irrigation, Potato Diseases and Cultivation.*

To make the best use of water and to delay air exclusion, if possible until the cooler weather of late July and August, irrigation is put off until the plants show considerable signs of suffering for water, or until in most cases after the first blossoms have opened and the tubers set. In most seasons there is moisture about the lower roots sufficient to sustain the plants, but as no rains come, there is not moisture enough above the seed piece, and no tubers are set until well into August, because tuber stems do not start unless moisture is in actual contact with the main stems. This is the chief reason for hilling potatoes—to more thoroughly mulch the soil about the main stems, and is said to have been discovered in Germany in the early days of potato culture there. It is one of the basic principles of potato growing.

Thus in the Greeley system the deep close cultivation tears off side roots, dries out the soil, and reduces the food supply at and prior to blossoming time. A well known scientific law which applies both to animals and as here to plants has been formulated by Doctor J. C. Arthur of Purdue University as follows: "A decrease of nutrition during the period of growth of an organism favors the development of the reproductive parts at the expense of the vegetative parts." With this fact all the farmers are familiar in its application to farm animals, and, in Colorado, growers of wheat and of alfalfa for seed production know that the withholding of water at a certain stage of growth increases the set of seed.

Associated at Greeley with methods that reduce the supply of available food at the budding and blossoming season, we have an unnatural delay of tuber formation, and the use of food therefore, followed, when irrigation at last commences, by the instant availability of a large food supply. Thus we have all the requisites for variation* of the plant in all its parts at the time of tuber growth in the direction of any impulse given it by previous conditions. Disease is also a large factor, often the largest factor, in potato plants tending toward going to seed. Often when the underground stems and tuber stems are attacked, especially in rich conditions, by fungous disease, there is induced a trouble called in Colorado "Little Potatoes." The prominent symptoms of this disease are the growth of large vines and many and large side branches, and the formation above or just below the ground of many small knotty tubers. These side branches blossom profusely, even when grown from tubers borne by prolific non-blossoming plants, but do not appear, the first season, to bear pollen.

*Abundant food supply is recognized by plant breeders as promoting or allowing variation, reversion, or "sporting;" and wild plants are considered to be more stable and uniform in their characteristics because struggling in nature with other plants for food, they are less richly nourished than when cultivated by man and thus favored, protected and allowed to develop freely their inherent qualities.

Professor Alvin Keyser cites the work of Professor E. G. Montgomery, which affords a somewhat parallel phenomenon with Indian corn. About fourteen nodes are typical of the corn stalk, the upper seven of which are long and may develop tassels or male flowers, while the lower seven have power to develop female flowers and ears of corn. Normally one or two ears are formed and at upper nodes of the lower seven, but in the case of accident or removal of the ears naturally developing, ears may be formed at other nodes, and experimentally it has been found possible to induce the development of ears at all of the nodes.

The Influence of Nitrogen.—"Speaking generally, excessive food supply leads to infertility among both plants and animals. The former vegetate luxuriantly, but they do not blossom and fruit so abundantly as under a full but moderate supply of plant food." We were justified in making the assertion "that extreme proportions of nitrogen produce luxuriance in stem and leaf at the expense of flower and fruit."* Potatoes need rich conditions to continue productive vegetative growth. Experimentally and in commercial practice we find that seed potatoes grown from good stock and under good early conditions of moisture and health, but with only a moderate amount of plant food, on our buffalo sod or sage brush ground,† expand into remarkable vegetative and tuber growth when planted on our rich alfalfa lands, are most nearly asexual in habit, and have the finest tubers the first year, with usually the largest production the second season.

Change of Soil.—Change from one region to another, or from one farm to a different but not richer soil, affords a change of food which is also a stimulus to potatoes and retards sexual development, thus maintaining to a degree good tuber shape. We find, however, that constant change may hold in suspension for several years the tendency to seed bearing and tuber degeneracy, which may then come suddenly, on return to less favorable conditions, or on being grown for a second year on the same ground.

Identity of Tuber Parts.—Aerial tubers give the best proof of the morphology of tuber parts. Plate VII is a Pearl plant from which the tubers were removed by hand in 1910 at Del Norte. In this case the plant not only enlarged upper branches, many of which formed into tubers, but also enlarged the main stem with normal potato-tuber tissue. In Plate VI, page 2, note a Pearl tuber also from Del Norte in 1910, the result of disease. One portion of the tuber was grown above ground and one below. These tubers show that the eye yoke is the laying of the leaf onto the stem; that the yoke point is the remnant of the leaf stalk base; that the sprout tips are the ends of leaves later to be followed by the sprouts; that knots are swelled, protruding branches of tubers; and that "compound" eyes are but lesser knots. The emphasis of the yoke on aerial tubers is quite like the dif-

* E. Davenport in Principles of Breeding, 1907, page 226.

† To a less degree this is true of seed potatoes grown upon pea stubble.

ference of main stems below the ground and above. Below ground the stems are smooth, while above ground potato stems are squared by successive leaves whose bases spring from the stem. In Pearl bastard seedlings, which are strongly sexual, the stems are squared—even winged by the leaf stems.



PLATE VII.

Pearl Aerial and Main Stem Tubers.
The result of removing natural tubers.

Color and Degeneracy.—With the old Peachblow, and with Pat's Choice and other varieties, the pink color follows the yoke lines, and strong color seems associated with sexual or degenerate tubers. With Ohios and improved Peachblows, the better the conditions the lighter the color of the tuber, and the worse the conditions and the type, the deeper the red color the heavier the yokes and the deeper the eye pits or the more protruding the eyes. With Ohios, knots and seed ends are often of color diverse from that of the main tuber, or of other knots, possibly from varying influences during growth. Similarly, we often note different types on the same tuber, and we have a photograph of a Cobbler tuber, which is long, and in three sections—the first round, the second elongated, and the third a true Cobbler again. Peachblow tubers often project the main stem forward with all the end eyes and form

either a new tuber or an end knot, usually of a darker red color.

HYBRIDIZING.

The Pearl is one of our healthiest varieties, is medium early and a heavy cropper. If in a large selection of hybrids with the Rural we could find one plant which retained the desirable qualities of the Pearl with somewhat more of the balance and smoothness of the Rural tuber, the value to the Colorado industry would be great. At Del Norte, in 1910, Francis Chisholm made sixty-seven crosses both ways between the two varieties. Twenty-five seed balls were secured but a hail storm

reduced the number to seven. One of these was of Rural pollen on Pearl and contained no seeds. The six of Pearl pollen onto Rural all bore abundant seeds. We judge incomplete fertilization characteristic in Colorado of Rural pollen and of the pollen from the Early Rose family as we cut open 650 seed balls of these sorts and found no seeds.

Next to the improvement of the Pearl, the most important work of this kind in Colorado is the introduction of some more disease resistant factor into both vines and tubers of the Rural family, and this result may be obtained in connection with the improvement of the Pearl.

A third object is the securing of a better early variety than the Ohio or the Cobbler. If the desirable qualities of these two varieties can be combined, the benefit will be very great to all who grow or who eat potatoes.

Our experience indicates that the crossing of varieties can be done with the best success at Greeley and Del Norte, and that selection and development is likely to be most successful at Carbondale. We find also that the best conditions for final seed potato production are likely to be those of the dry regions of Northeastern Colorado or of the Arkansas divide, and of high sage brush lands under ditch.

It is calculated that if Pearls can be made to run smooth and not knotty, and Rurals made more healthy and a little earlier, that the Colorado crop will average to be worth at least five per cent. more money. Such improvements should be accompanied by at least an equal gain in yield, as herein foreshadowed, so that we may expect such work if eventually successful to increase the returns from potato growing at least ten per cent. in Colorado. This percentage on our crop is already \$600,000 per year.

BALANCE: A NEW TERM DEFINED.

Balance may be here defined as the proper relative growth of the main stem, branches, and leaves and the proper relative influence indicated by aerial tubers to be exercised by each upon the shape of tubers formed by the swelling of underground stems. Eyes are shallow when the leaves and branches are in balance each with the other, and affect the surface of the potato equally. With such potato vines as have strongly sexual main stems tending to become seed stalks, the branches of the main stem are relatively weak and short while the leaves and the leaf stalks are very strong so that the main stem is crooked and takes an altered direction from every point of division from the leaf stalks. In the tubers borne by such plants, the leaf yokes are very prominent and the bottom of the eyes, which are the tips of the branches or sprouts, are receding, thus forming deep eyes. In such tubers in most cases the number of branches and the number of leaves included within the tuber are increased so that the tuber is relatively long with many and deep eyes. The formation of such tubers from stems whose counterparts above ground bear many short branches and many stiff

leaf stalks growing from a stem of elongated character may be conceived to account for such tubers being circular rather than elliptical in cross section. The better the balance of tubers the flatter they are and the more run out the more nearly circular their cross sections.

Strong side branches and the tendency of branches to turn upward appear to be coordinated with tubers being flattened, as are all our sorts to some degree when most productive, and with the fact that most of the eyes of such tubers are on the upper side. When first formed, such tubers are not flattened, the Rural for instance being, when newly formed, circular in cross section, and later flattened.*

Aside from the above stated element of proper balance in potato plants, there is another element of balance, the tendency of stems either to stop growth before the tuber growth ceases, or to go ahead of the growth of tuber parts and tissue. The improved Peachblow potato is perhaps the best example of this. It has in many cases a recessed seed end, and in many cases it renews growth from this end, forming, especially with seedlings, which are more sexual, a series or even a "necklace" of tubers on one stem. In this variety also there is a noticeable tendency for growth to start from within the tuber, possibly from dormant buds. Large tubers of this variety crack very seriously and within the cracks are found what appear to be internal tubers or knots bearing eyes like those on the exterior surface of the original tuber. When flattened, large Peachblows seldom crack.

The element of balance shows in Pearls in another way namely that tuber stems of more strongly sexual plants are more subject to the tendency of the branches to grow and form knots. Growers commonly say that uneven watering occasions knots, and they are undoubtedly right, except that the tendency of previous years is perhaps a more important factor.

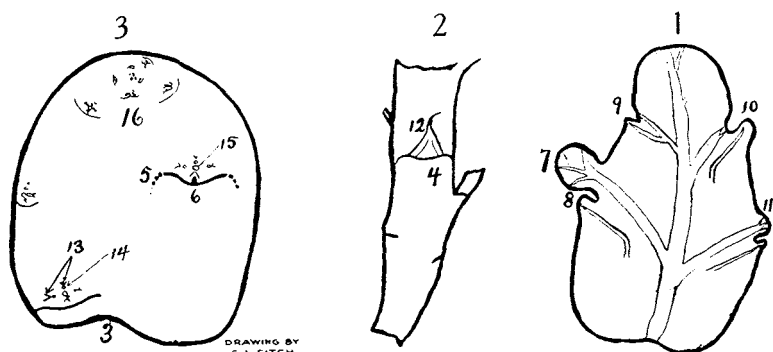
HARMONY OF PLANS FOR POTATO BETTERMENT.

It is a great satisfaction to feel the entire harmony of objects sought in potato breeding. Within the bounds of a variety the largest yields, the most desirable flattened tubers, and the shallowest eyes, go together. Conditions that favor one of these qualities favor the others. The largest profits to growers, and best quality for the housekeeper come from the same fields. Undesirable cylindrical shape, undue length of tuber, bulging or "compound" eyes, knots, deep eyes, and irregular shape, altho affected by varietal differences, appear to have common causes and common remedies.

*Flattened seed tubers, other things being equal, may be expected to be most productive. We have noted this with Snowflakes and have found the Russet to be quick to respond to selection of wide seed tubers. At Carbondale, in 1910, we obtained from wide seed Russets 6,257 pounds per acre more than from slender round tubers of the same stock.

TUBER PARTS NAMED.

This plate is prepared to make clear the definitions herein given of tuber parts and defects. The plate is numbered from 1 to 16, as below explained.



TUBER NOMENCLATURE; PLATE VIII.

1. Longitudinal section of a tuber with defects.
2. A portion of the main stem of a potato plant.
3. A Pearl tuber with *recessed stem end*.
4. *Leaf Yoke* or line of separation of the leaf from the stem and corresponding to the eye yoke at No. 5.
5. *The Eye Yoke* on a good tuber has only the central portion. On degenerate tubers, it is stronger, and on aerial tubers runs down at the ends as indicated by the dotted line at 5.
6. *The Yoke Point* is absent on the best tubers but is strong on the sexual tuber shown on Plate VI, page 2. No. 6 corresponds to No. 12, the stub of the leaf stalk.
7. *A Knot* or protruding tubered branch, accompanied by a deep eye pit.
8. The *eye pit* is here deep.
9. A deep *eye pit* without a knot.
10. A heavy *eye brow* and a deep eye pit.
11. A *compound eye* and a deep eye pit.
12. The *stub* of a leaf stalk, corresponds to No. 6, the *yoke point*.
13. *Eye blinds* are little bracts just *outside* the sprout tips.
14. A *side sprout tip*.
15. A *main sprout tip*.
16. The group of eyes here suggests the growers' name, *seed end*.

GOOD PEARL SEED POTATOES: TEN RULES.

Founded upon the foregoing or explained thereby.

PEARL SEED IS BEST TO BE:

1. From a field free from bloom and the ragged appearance produced by the presence of many vines of types Nos. 3 and 4
 2. Of true Pearl shape without yoke points or deep eye pits, and with the fewest possible knots and compound eyes.
 3. From dry land sod or high altitude irrigated sage brush lands with plenty of slope.
 4. Brought from less to more fertile lands—not the reverse.
 5. Exchanged between farms of the same region, rather than kept on the same farm.
 6. Not from land where, if soil diseases are a factor, the crop was grown after potatoes.
 7. From fields watered early, where slope and temperature allow this to be done without causing disease.
 8. If from above the ditch, from summer fallowed lands planted rather deeply.
 9. From fields which produced a good yield of medium sized tubers, and did not run too large, because in the latter case the tubers of seed size are apt to come from the weaker hills.
 10. From special seed patches planted close, and perhaps dug early.
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CHANGE OF PLACE OR SOIL is not the whole problem.

THE TYPE OF THE TUBER does not answer all our questions.

AT LEAST THREE YEARS HISTORY of the stock is necessary.