ounces to fifteen pounds, and which loses its colors and spots when it enters the sea or when it reaches a large size. Similar changes are shown in each of the four coastwise species of trout of the Pacific coast.

The explanation is apparently this. The trout in Loch Leven is identical as to species with the ordinary brook trout of England. The character of the food supply and of the water of the lake determine its color and appearance. These acquired characters are not hereditary, but are results of conditions in the growth of the individual. The lake trout planted in the brooks grow as other brook trout do. In estuaries of rivers they assume still other characters, and these are equally temporary.

I have no doubt that Dr. Day is right in regarding the large salmon trout of the English bays (*Salmo trutta* L., *Salmo eriox* L., *Salmo cambricus, Salmo albus, Salmo phinoc, Salmo brachypoma*), the golden trout of the estuaries (*Salmo estuarius, Salmo orcadensis, Salmo gallivensis,* etc.), the silvery trout of the various lakes (*Salmo levinensis, Salmo cæcifer*), the great black lake trout (*Salmo ferox, Salmo nigripinnis*), the 'gillaroo,' with the stomach coats thickened (*Salmo stomachicus*), and the common trout of the brooks of northern Europe (*Salmo fario* L., *Salmo ausonii, Salmo gaimardi, Salmo cornubiensis*) as all forms of one and the same species. A member of one of these so-called species would be changed to one of the others if it grew up under the same surroundings. These forms are not subspecies, for that implies a divergence which should be hereditary, however slight. They are, if this view is correct, local variations of one species, for which the oldest name is the half-forgotten one of *Salmo eriox* Linnæus.

A practical question with fish-culturists arises here. "The riparian proprietor," says Dr. Day, "sends for, let us say, *Salmo ferox,* to improve the strain of his local race by crossing, and after a year or two he feels confident that the imported forms are only brook trout. Naturally indignant, he may come to the erroneous conclusion that the purveyor has imposed on him and it will not be until he understands this is a simple variety attaining a large size, due to certain local circumstances, that he will comprehend how his money has been thrown away. He had far better look to the food and condition of the water on his estate before attempting to improve the indigenous breed."

DAVID STARR JORDAN.
STANFORD UNIVERSITY.

THE RELATION OF SOIL TEXTURE TO APPLE PRODUCTION.

THE problem of the intelligent selection of an orchard site by a person who contemplates engaging in the production of apples on a commercial scale, or even in a small way, resolves itself into several factors. The climate must be suitable and the physiographic features, including exposure and the attending surface conditions, aeration and drainage, must be favorable. The relation borne to variety by climate, and to a lesser degree by physiographic position, must be carefully determined, for whereas a considerable part of the United States is suited to apple production, certain important varieties, as the Albemarle Pippin, may be successfully grown only in very restricted areas. Other varieties, such as the Baldwin, succeed over a large scope of territory, but still are adapted to only a small part of the general apple belt, while the extent of the range of adaptability of countless other varieties may be said to lie somewhere between those of the two varieties mentioned. Such limitations of variety, however, are known in a general way and with this fund of past experience available the planter need not go far astray in the selection of varieties for his orchard. In the Albemarle area, Virginia, for example, Mooney found that the York Imperial grew to the best advantage in a valley; whereas 'on the eastern side of the Blue Ridge it ripens early, and falls, and does not have as good keeping qualities.'

Again, the Albemarle Pippin[1] thrives on

[1] See Report on the Albemarle Area, U. S. Dept. of Agriculture, Field Operations of the Bureau of Soils, 1902. Report on the Mount Mitchell Area, U. S. Dept. of Agriculture, Field Operations of the Bureau of Soils, 1902. Report on the Bed-

Porter's black loam 'when this type occurs in sheltered mountain coves.' In this case the 'rich, mellow and deep' soil which this variety requires is of little avail when not in conjunction with a sheltered physiographic position which shall so determine the conditions of exposure and aeration as to produce fruit without any cloudiness or imperfection of skin, as either of these conditions detracts to a particular degree from the value of this variety in the somewhat exacting markets to which it goes.

It was also found in the Albemarle area that a loamy phase of the Cecil clay was very satisfactory for Winesap apples, but not as good for the York Imperial, though these varieties seem to do equally well on the Hagerstown loam in the valley of Virginia. If, however, lime be applied to the Cecil clay, the York Imperial is produced as successfully as the Winesap. This indicates one or both of two things: that the soil is acid and that the York Imperial can not overcome this tendency as well as the Winesap, in which case a chemical corrective is required; or that the former variety is more susceptible to the undesirable influences of a soil with texture as stiff as that of the Cecil clay, but that this textural condition is somewhat ameliorated by the application of lime.

Near the southern limit of the apple belt increased elevation so modifies climatic conditions that fruit is successfully produced between the altitudes of 2,500 feet and 3,500 feet in a latitude where at lower levels fruit does not succeed, and within the zone mentioned the climatic relations are further illustrated by the fact that near the lower elevation apples do best in coves on the north side, while in the higher mountains, where it is cooler, south coves are equally good, or perhaps even better, than the north coves.[2]

Other similar specific local problems relating to variety, surface and climatic conditions are not uncommon, and in each instance must be solved for the locality under consideration. Aside from these local qualifications, however, a most important problem which may not be evaded and is of much more general scope remains in the selection of the soil, for upon it depend in large measure the returns from a long-term investment.

In this selection of the soil the ideal to be kept ever in mind is that soil which will produce the greatest quantity of fruit of the best appearance and of the best quality for the longest possible term of years; and he who would be most successful must consider with infinite care not only each of these desiderata in its specific relation to the soil, but also the combined relation of the three to the soil in question. That is, the soil either must be naturally productive or capable of being brought to a high degree of productiveness; its inherent characteristics must be such as to produce fruit not only attractive in appearance when marketed, but also of the highest quality, if the producer is sufficiently farsighted to recognize that in the long run the greatest profit is to come to him who from the very beginning uses his every endeavor to establish and to maintain permanently the reputation of producing the highest possible quality of fruit demanded, or for which a demand can be created, in the best markets; and finally the soil should be capable of sustaining trees in a profitable bearing condition for a long term of years.

Soils possessing one or two of these characteristics are plentiful, and a large part of the orchards already in existence not only show conclusively certain very desirable traits in such soils as exhibited in growth of tree or in character of fruit, but also indicate the importance of the other qualifications mentioned, if these orchards are to be a commercial success. This is well illustrated, for example, by orchards in the Middle States located on a deep, sandy soil (the Miami sand). This soil is found in a district noted for its successful crops of apples, yet it possesses at most but two of the required attributes. The color of the fruit produced is excellent, and the quality thereof is very good,

ford Area, U. S. Dept. of Agriculture, Field Operations of the Bureau of Soils, 1901.

[2] Report on the Mount Mitchell Area, U. S. Dept. of Agriculture, Field Operations of the Bureau of Soils, 1902.

but the soil is not of such a character as to effect a satisfactory growth of tree, and the bearing life of the tree is so short as to make it manifestly ill-advised to plant orchards upon this type of soil, except possibly to furnish a household supply of fruit.

Similar results observed upon the Norfolk sand and certain light sandy loams, and sandy gravelly loams of the Atlantic seaboard, show clearly that there is a limit in the coarseness of soil texture beyond which the soil can not be used for profitable apple culture. That this limit can be definitely established by further study, particularly if pursued in a comparative way, is, it is believed, unquestionable.

To go to the other extreme of soil texture, many clays and heavy clay loams are either productive or capable of being made so when put into the proper physical condition, and when so improved yield good crops of general farm produce. Apples grown under such conditions, however, as observed on certain fields of the Miami clay loam in Oakland County, Michigan, on the Dunkirk clay in the Champlain Valley, on the Hagerstown clay in Adams County, Pennsylvania, and on local areas of the same type in the Pikeville area, Tennessee, are inclined not only to have greasy skins, but also to be inferior in color, and so fail to command the highest prices. Furthermore, when the subsoil passes a certain stage of stiffness, namely, a texture so close that the roots do not penetrate readily and freely to a depth of several feet, satisfactory growth of tree and consequent quantity of fruit are also impossible.

That these tendencies are largely textural problems is shown on the last two types by local areas containing considerable chert or small stone fragments which serve to loosen the soil. From such areas the fruit has a much clearer and better colored skin, and the greasy characteristic is much less prevalent.

The statement is heard frequently that the apple will succeed on any soil which will produce a good crop of corn. No preconceived idea related to apple growing is more dangerous, perhaps, than this one. That good corn soils may be favorable for apple production is unquestionable, but that the opposite frequently is the case may be best illustrated, possibly, by a concrete example: The best corn soil in the United States which occurs in considerable areas is, probably, the deep, black prairie soil of the middle western states, the Miami black clay loam. But for apples it is found to be favorable only in so far as it conduces to a rank growth of tree. This tendency, indeed, is so marked upon this soil that the yield of fruit is, as a rule, materially lessened, at least until the tree has attained a considerable size. The tree, moreover, is not hardy, the color of the fruit is decidedly inferior, the grain of the fruit inclines towards coarseness, the flavor is never the best, and the keeping qualities are but mediocre. This is, of course, an extreme case, but it represents, nevertheless, a definite tendency of all that class of soils which possess in any marked degree the characteristics of this type.

Having ever in mind the ideal results already defined, as regards quantity and quality of fruit, and the extent to which they are influenced by the character of the soil *per se*, it will be interesting to develop some definite conclusion concerning the soil characteristics which contribute most fully to these ends. Discarding sands and clays for the reasons already noted, there is left a large class of soils ranging at the surface from sandy loams to clay loams, with the subsoils presenting a similarly wide range of variation.

The apple tree under favorable conditions is a vigorous grower, and has an extensive root system. Such a root system can be developed only where the soil particles are of such size and arrangement as not only to allow free root penetration to considerable depths, but also to retain such amounts of moisture as shall be favorable to root growth, and not allow available plant food to be leached away more rapidly than the tree's needs. These two characteristics, however, start from opposite textural extremes and it is only as they approach each other that a satisfactory condition exists. A light sandy subsoil allows free root penetration, but is not sufficiently retentive of moisture and dissolved plant food to supply the needs of the tree. In fact, if we

investigate a series of soils, keeping constantly our problem in mind, we shall find that the essential characteristics—such as moisture supply, retention of plant food and consequent extensive root growth—are all enhanced as the subsoil becomes heavier in texture until the stage is reached where the roots find their progress somewhat hindered mechanically. Beyond this stage of fineness in texture it is ill-advised to go, for diminished returns from the orchard will be sure to follow in proportion as this limit is exceeded. While this point of texture might be fixed theoretically, it is obvious that it may not be so decided from a practical working standpoint, and even if it could be there are probably too few soils of this exact nature in regions possessing the other favorable attributes to supply the apple trade. There are a great many soils, however, whose subsoils are sufficiently near this ideal to bring satisfactory results. Such subsoils range from very heavy sandy loams to clay loams, limited only as already mentioned, thus including the broad class of loams which increase in desirability as they approach the clay loams.

Inasmuch as the subsoils described can be depended upon largely to contain the optimum, or at least favorable, supply of moisture, and to maintain until needed a corresponding concentration of all available plant food, it follows that with them the conditions are supplied to produce a satisfactory growth of tree for a long term of years, provided a sufficient supply of plant food exists in the soil. If the surface soil be too heavy, however, any one or more of several unfavorable results might follow. When the young tree is transplanted from the nursery a great deal depends upon its ability to establish a healthy, normal and extensive root system the first year. This must be done at first within the limits of the surface soil, and is impossible of realization unless that medium is so mellow and non-resisting that the tiny roots and fibrils may be free to develop in all directions. These conditions are manifestly best obtained in soils not heavier than a medium loam nor lighter than a medium sandy loam. Ready drainage of the surface soil, which is also imperative, would be impaired if the soil were too heavy, and the detrimental effect would be apparent not only in the limited growth of tree and its ability to resist disease, but also when the tree should reach its bearing stage, in the coloring of its fruit.

The influence of the character of the soil is again felt, especially in the more northern districts, in the opportune time of the maturity of the fruit. Apples grown on light sandy soil are often ready for picking before the weather is suitable to place them in ordinary storage, while if placed in cold storage the attending expense is much greater than for fruit which matures later. On the other hand, trees grown on clay, or the heaviest clay loams, may continue their growth so late in the season that the fruit does not reach the most desirable state of maturity before it must be gathered, and the trees themselves are not so well prepared to withstand the severities of the winter climate.

The color of the fruit when harvested, furthermore, can be best only when the fruit has reached the proper stage of maturity before it must be picked. It is understood, of course, that no soil can produce highly colored fruit unless the trees are so trimmed and trained as to admit sunlight freely. Assuming that this has been done on all soils alike, and holding our comparison to data gathered under identical, or at least very similar, climatic conditions, then it may be stated that highly colored fruit may be best obtained on soils not heavier than the limit already given. Fruit of excellent color, nevertheless, may be grown on very sandy soils, as was said in connection with that class of soils, but unsatisfactory tree growth more than offsets this desirable characteristic and so eliminates such soils from serious consideration. It is thus seen that the most desirable soils from the color standpoint fall within the range of texture most desirable from the other points of view already considered.

The fact that unsuccessful orchards are frequently seen on the classes of soils already designated as desirable for apple culture most often indicates some form of neglect in methods of culture, including the mechanical con-

dition of the soil, failure to rotate crops where clean cultivation is not followed, lack of proper trimming, failure to control injurious insects, fungus diseases, etc., or that there is insufficient plant food available. Orchards are sometimes seen, however, in which all these external conditions have been carefully attended to, the trees are thrifty, and still the fruit lacks color and quality. This condition involves a chemical problem and usually indicates, as proved in numerous instances, that the supply of available potash is insufficient for the tree's needs—a lack which must be supplied by rendering available the unavailable potash already in the soil, or by the application of further material in an available form.

Another important problem arises at this point, that is, the relation, if any, which exists between diseases of various kinds to which the apple tree or its fruit is subject and the conditions, as related to the soil, under which the trees are grown. Mr. G. H. Powell, of the U. S. Department of Agriculture, stated in an address to the Western New York Horticultural Society, in 1903, that 'at the present time we would say that the practical control of the scald is primarily an orchard problem and depends on cultural conditions that develop the best and most highly colored fruit.[3] This being the case, it appears that this malady may be avoided, in some measure at least, by selecting soils which, with other things equal, tend to produce 'the best and most highly colored fruit.' It thus seems possible, and indeed probable, that soils in themselves may have a most direct influence upon the character of the tree growth and fruit growth which shall the better enable these to resist certain forces of disease besides the scald.

That the highest quality of fruit should be obtained on a soil which produces a tree neither stunted nor too rank in growth, but normal, well developed and hardy, and consequently productive of fruit the most attractive in appearance, is a natural inference. Sufficient proof of this point, however, is not at present available, but a field of investigation is opened which will become steadily more important as the already noticeable demand for a higher quality of apples increases.

HENRY J. WILDER.

[3] See Proceedings of the 48th Annual Meeting of the Western New York Horticultural Society, 1903.

A CORRECTION OF THE GENERIC NAME (DINOCHŒRUS) GIVEN TO CERTAIN FOSSIL REMAINS FROM THE LOUP FORK MIOCENE OF NEBRASKA.

WHILE in the field during the past summer (1905) the writer sent to Dr. W. J. Holland (director, Carnegie Museum) a preliminary note on certain fossil remains of the family Suidæ from the Loup Fork Miocene of Sioux County, Nebraska. I proposed *Dinohyus hollandi* as the name and asked Dr. Holland if he would kindly look to see if that generic name was preoccupied before publishing the note. In reply Dr. Holland wrote me that *Dinochœrus* 'appears to be a better word,' and that it was not preoccupied. I agreed to the change, but find that the name *Dinochœrus* has been used by Gloger, for a South African hog (*Hand- und Hilfsbuch Naturgeschichte*, I., pp. xxxii, 131, 1841), and, therefore, propose my original name *Dinohyus hollandi* for the fossil remains, which was published in SCIENCE, N. S., Vol. XXII., No. 555, pp. 211–212, August 18, 1905.

O. A. PETERSON.

CARNEGIE MUSEUM,
October 24, 1905.

QUOTATIONS.

ACADEMIC FREEDOM IN JAPAN.

PROFESSOR TOMIZU, most eminent of Japanese authorities on Roman law and professor in the Imperial University, Tokio, has lost his chair, arbitrarily removed by the minister of education, owing to his passionate denunciation of the ministry for the terms which it authorized Japan's representatives at Portsmouth to accept. He is one of a group of seven professors in the university who have been critical of the ministry ever since the war with Russia began.

Professor Tomizu's eminence together with the radical nature of the government's con-