spectrum of a solution with concentration, the above experiment has an obvious defect, viz., that the thickness of the layer of the strong and weak solutions being equal, the numbers of the salt molecules through which any ray of light passes are very different in the two cases. It should therefore be supplemented by showing also the color or the spectrum obtained when the light is passed through a wide trough of the dilute solution, the ratio of the widths of the troughs being the reciprocal of the ratio of the percentages of salt in the two solutions.

(3) Dr. W. W. J. Nichol's observation (Phil. Mag., Ser. 5, xix., 453) that anhydrous sodium sulphate will dissolve in a supersaturated solution of that salt may readily be shown as a lecture experiment by projection. For that purpose place a test tube containing the solution in a trough with glass sides full of water, and focus it on the screen. Then let the anhydrous salt in the form of a fine powder, fall upon the surface of the solution. By taking a pinch of the powder between the thumb and forefinger (both being quite dry), it may be made to fall as a shower of fine particles. These pass into the solution and are seen to move slowly across the screen through the solution, dissolving as they go, in some cases disappearing, and often changing the concentration of the part of the solution through which they have passed, so as to produce obvious refraction effects. Finally, to show that the solution was supersaturated, add a few crystals of the hydrated salt and crystallization at once occurs. The anhydrous salt must be added as a shower of fine powder, as larger pieces may — by taking up water and forming crystals of the hydrated salt before they can dissolve it — give rise to a general crystallization of the solution.

(4) The peculiarity of the solubility in water of such substances as aniline, carbolic acid, etc., observed by Alexejew (Wied. Ann. Bd. XXVIII., 305), may readily be shown on the screen, by using carbolic acid, whose critical temperature (the temperature above which it and water are mutually infinitely soluble) is about 69° C. For this purpose, pour some of the acid into a long test-tube, of about twelve or fifteen millimetres in diameter, and add water. The water will lie in a layer above the acid. Support the test-tube by a clip grasping at the top, and focus on the screen. The line of demarcation between the two liquids will be evident. Now mix the liquids by stirring, and the whole becomes cloudy. Let the tube stand, and the liquid separates again into two layers, having different depths from those they had before, both being now solutions. As this process requires considerable time, the stirring may have been done beforehand. Next surround the test-tube by a beaker of boiling water, passing it upwards from below, and stir the liquids with a hot glass rod. A slight cloudiness appears, but the liquid quickly clears and is seen to have become homogeneous throughout, the line of demarcation having disappeared. If now the beaker of hot water be removed, and one of cold water be substituted for it, the liquid becomes cloudy, a strong solution separating out everywhere, and the little spherical masses of strong solution sinking and coalescing as they sink, to form larger spheres. After a time the liquid is seen to have again become separated into two layers. If the necessary time is not available, the separation into layers may be obtained very quickly by removing the beaker of cold water and again applying the hot bath, which, raising the temperature, stops the separating out of the strong solution and re-dissolves it in the surrounding weaker solution, thus producing a comparatively strong solution in the lower part of the tube and a comparatively weak one in the upper part. The experiment requires but a few minutes and is both striking and instructive.

SOME DISEASES OF LETTUCE AND CUCUMBERS.

DURING the past winter and spring James Ellis Humphrey, professor of vegetable physiology at the Massachusetts Agricultural Experiment Station, has been engaged in the study of certain diseases of lettuce and of cucumbers, cultivated under glass. The investigation of some of these is sufficiently advanced to justify the following preliminary announcement, given in Bulletin No. 40 of the station mentioned.

The rotting of lettuce has been a source of much loss to gardeners who cultivate that plant as a winter crop, but its cause, and, therefore, proper preventive measures, have not been known. It usually appears first just above the surface of the soil at the attachment of the lower leaves to the stem, and then spreads to the centre of the head, causing the stem and the bases of the lower leaves, and later the whole of the tender inner leaves, to become decomposed into a slimy mass. The larger leaves being thus cut off from the stem by decay at their bases usually dry up; and there appears after a time, on the remains of the plant, if left undisturbed, the erect, spore-bearing threads of one of the imperfect fungus forms known by the name *Botrytis* or *Polyactis*. The vegetative threads of this fungus are to be found in the decaying tissues of the host in the early stages of the trouble, and no other fungus has ever been observed in connection with it. The professor's observations make it practically certain that the disease is due to the fungus-form mentioned, and this view is supported by the fact that similar forms are known to produce similar diseases in some other plants. This fungus appears to be able to develop also a saprophyte on old lettuce-leaves and other vegetable refuse, and may thus survive a long interval between two crops of lettuce, resuming its parasitic habits when the opportunity is afforded.

From what has been said, it is evident that careful and thorough treatment is essential to the control of the disease in question; and the nature of the crop limits this treatment to the removal of all sources of infection. All affected lettuce plants should be at once removed wholly from the house and destroyed by burning. For this purpose the boiler furnace is conveniently at hand. All dead leaves or other refuse should be often scrupulously cleaned up and burned, so that no breeding places may be left for the fungus. A house which has been very badly infested by the disease should be thoroughly cleaned, whitewashed, or painted, and supplied with fresh soil before a new season's operations are begun; and one may then expect, with the observance of the above described hygienic precautions, to be able to enjoy comparative freedom from loss from this cause.

The powdery mildew of the cucumber is due to the presence of a fungus which has been long known, but which has not been heretofore reported as occurring in America, so far as can be learned. It has been received during the past season, on leaves of greenhouse cucumbers, from Dr. Jabez Fisher of Fitchburg and from Professor L. H. Bailey of Cornell University. The fungus, as has been said, attacks the leaves, on whose upper surfaces it forms at first rounded spots, which appear like blotches of a white powder. These spots gradually enlarge and become confluent until the leaf is practically covered. Those parts of the leaf which are attacked soon turn yellow, and finally become dead and dry. Under favorable conditions the disease spreads quite rapidly and is very destructive.

The fungus which causes the trouble is known as *Oidium erysiphoides* Fries, var. *Cucurbitarum*, and is the *conidial* or summer spore stage of one of the fungi known as "powdery mildews." It is impossible to say certainly to which of the perfect or winter spore forms of the group it belongs.

It has been found by Professor Bailey and by Dr. Fisher that the fungus may be kept in check by frequent spraying with a solution of sulphide of potassium (liver of sulphur) in water. The proportion usually given is one ounce of the sulphide to two gallons of water, but both Dr. Fisher and Professor Humphrey have found this solution injurious to the foliage and the young cucumbers. A preparation containing an ounce to three gallons is certainly strong enough, and one with an ounce to four gallons is probably so.

As recommended for the lettuce disease, a house in which this fungus has been troublesome should be thoroughly cleaned and fumigated before the next season's crop is started.

THE AGRICULTURAL PRODUCTS OF MADAGASCAR.

M. D'ANTHOUARD, Chancellor of the French Residency at Antananarivo, has recently made to the French Government an interesting report upon the economic condition of Madagascar, a translation of which appears in the *Journal* of the Society of Arts

for July 31. In that portion of the report which is devoted to the consideration of the agricultural development of the island, it is stated that the chief agricultural products are sugar, coffee, cocoa, vanilla, cloves, rice, potatoes, tamarinds, indigo, wine, oranges, and lemons. Sugar cultivation was first commenced in 1842; and two factories were erected at Manangary. Good results were obtained in the first two years; but, during the third year, riots took place among the workmen, and the plantations were destroyed. In 1878 three new factories were established in the neighborhood of Tamatave; and in 1883, on the outbreak of hostilities between France and Madagascar, they were in full working. At the present time, the number of plantations round Tamatave has greatly increased; and also in the south, towards Mahanoro and Vatomandry. The expenses of cultivating are greater near Tamatave, by reason of the high price of land and the scarcity of labor, than in the south, towards Vatomandry and Manangary, where labor and land are cheap. Leases are usually granted for twenty-five years, renewable at option. They may even be granted for a period of ninety-nine years.

Coffee trees grow well in Madagascar; and it is stated to be by no means an uncommon thing to see plantations that are forty-five years old, and even more, which have never ceased to yield good results. European travellers, it is said, are frequently struck by the healthy appearance and the quantity of berries in most of the plantations made round the houses or in the villages inhabited by the natives, even when these plantations appear to be abandoned and left to take care of themselves. A large plantation has recently been established in Imerina by a French company; it extends over an area of about 800 acres. Great results are expected from the development of the coffee industry in Madagascar, as the difference between the cost price and the price it realizes in European markets allows of a considerable outlay on its cultivation and then leaves a large margin of profit.

The cocoa tree was introduced into Madagascar by means of seeds brought from the Mauritius and Reunion, in which places it has been for a long time a source of considerable revenue. The tree commences to bear at the end of three years, but it is only in full bearing at the end of the fifth year, and it so remains for thirty years. The cost of cultivation is less than that of coffee. The cocoa tree is chiefly cultivated in the eastern portion of the island, and it is only of recent years that the industry has assumed any importance. In 1883 there were not less than five or six thousand trees round the coast, and these were abandoned when the war broke out. After the war it was found that, notwithstanding the want of care and attention, the young cocoa plantations were still flourishing, and this phenomenon encouraged the planters to pay greater attention to the development of this cultivation. This development dates from the year 1888. Like cocoa, vanilla is one of the agricultural products which has a great future before it in Madagascar, and its cultivation is largely engaged in in Vatomandry, Mahanoro, and Mahela. Vanilla plants commence to yield after the third year, and in the fourth they are in full bearing.

The cultivation of rice, which is well-developed in the interior of the island, is very much less so on the coasts, where the land is more fertile. While in the latter districts the inhabitants are content to sow the seed without any preparation of the ground but the burning of the trees and grass, the Hovas and the Betsileos, having a much poorer soil, take more pains to develop and perfect their system of cultivation. In some instances, for example, in the neighborhood of Antananarivo, they have transformed immense tracts of marsh land into rice plantations. The plains of Betsimitatatra, towards the west of the capital, which are watered by the Ikopa, Andromba, and Sisaony rivers, now the centre of the rice production in Imerina, have been drained and cleared, irrigating canals have been pierced, and everything has been done to favor the production. Similar well cultivated plains are found in great number in the south of Imerina and in Betsileo. In the mountain districts the rice grounds are laid out in terraces on the slopes of the mountains and hills, and rice grounds are frequently met with rising tier upon tier up to the very summit of the high mountains.

The following is the method of cultivation employed by the Hovas and Betsileos. The rice is first of all sown, then, when it has attained a height of fifteen centimetres, it is plucked up and replanted. The preparation of the ground is an operation to which considerable attention is devoted; it is first of all heavily manured, and when the seed is sown and commences to shoot up, it is subjected alternately to the action of the sun and moisture. In the transplanting, the same system is followed as in other rice-growing countries, care being taken to choose a wet season of the year. The ground must, first of all, have been subjected to various treatments, which would have the effect of transforming it into a kind of mud. In many districts this is effected by trampling over the inundated lands, already softened by driving herds of oxen over them. An improvement in the methods of cultivation practised by the natives of the coast, and of the means of transport, would, it is said, give to this industry its old importance. As regards the future of rice cultivation in the interior, it would never rise beyond the needs of local consumption, as it would be impossible for a low-priced product such as this to bear the heavy expenses of transport by land. Its cultivation, however, would prove remunerative to farmers and others if they would establish factories for the distillation of the alcohol obtained from the rice. At the present time, in the interior of the island, a tenth part of the rice lands only are cultivated, and this suffices for the requirements of home consumption.

Potatoes are largely cultivated in the districts round Ankaratra, and considerable quantities are placed upon the neighboring markets and at Antananarivo, principally for the consumption of the natives. Tamarinds are common all over the west coast, where the plants form immense thickets. The Sakalaves distil spirits from the fruit. Peaches grow almost wild all over the island, and the same may be said of the indigo plant.

As regards vines, there are different species in Madagascar. One variety was originally imported from Portugal; another variety appears to be indigenous to the soil. In Imerina attempts have been made in recent years to acclimatize vines, but some which were brought from Bordeaux have not succeeded. On the other hand, American vines have prospered, but the grapes are not of a superior kind, and the wine made from them is very poor. Orange and lemon trees are found all over the island, growing in a wild state on the coasts, and cultivated in the interior.

As regards textiles, ramie, flax, cotton, and hemp are grown. Plantations of the former were made at Vatomandry, in 1882, which have since increased. The want, however, of decorticating machines has caused this cultivation to be abandoned. Hemp is cultivated in Imerina and Betsileo. Cotton was formerly an important cultivation in Madagascar. The natives gathered it, and themselves manufactured the fabrics, which served them for clothing. Since the importation, however, of American and English cottons, the local industry has been almost killed. M. d'Anthouard says that in view of the fact that cotton grows so easily and quickly in Madagascar, more particularly in the territories bordering on the west coast, where it may be found almost in a wild state, it seems extraordinary that no one, up to the present, has thought of making cotton plantations, either for the export of the raw material, for working it up on the spot, and selling the yarn to the natives, or even for making fabrics which, seeing the heavy expenses of freight and transport which bear upon foreign products, would compete very favorably with similar American goods.

IS THE MARINER'S COMPASS A CHINESE INVENTION?

A WRITER in the *North China Herald* of Shanghai devotes a learned article to detailing and discussing the facts regarding the claim of the Chinese to have invented the mariner's compass. They did not learn the properties of the magnetized needle from any other country. They found it out for themselves, though it is impossible to point to the man by name who first observed that a magnetized needle points north and south. He suggests that it came about in this way. The Chinese have in their country boundless tracts of ironstone, and among these no small portion is magnetic. Every woman needs a needle, and iron early took the