mentier, for irrigating orchards and market-gardens in Syria, Palestine, and other countries subject to long summer droughts. The observations of M. Parmentier refer especially to the citrus gardens around Jaffa.

In arid climates economy in irrigation-water is obviously of the utmost importance. According to the method proposed by M. Parmentier, the water is applied direct to the roots of each tree by means of earthenware, cement, or iron pipes fixed vertically in the soil. The great losses by evaporation that always occur in open canals and in surface irrigation are thus avoided. M. Parmentier remarks that with vertical-pipe irrigation the water used in a citrus orchard was only 84 litres per hectare, as compared with 600 litres necessary for surface irrigation, applied every five to twelve days. At Jaffa there are 880 trees to 1 hectare ($2\frac{1}{2}$ acres) of citrus orchard, and 1100 plants in the banana gardens. These figures are very high, and imply a great consumption of water.

The method proposed by M. Parmentier is not new. Watering orchards by means of special drain-tubes sunk vertically in the soil is an old practice at Messina, in Sicily, where it is chiefly applied to young plantations. This method of irrigation was first described long ago by Prof. Giuseppe Inzenga, the well-known Sicilian agronomist and botanist, in the *Annali di Agricultura Siciliana*; and again by F. Alfonso-Spagna in his "Trattato d'Irrigazione" (Palermo, 1877, p. 502). In my book of agricultural chemistry ("Chimica Agraria, Campestre e Silvana," Napoli, 1902) this special method of drainage-irrigation is again described. The *catuso* used by the Messina gardeners is a conical earthenware pipe, about 1 metre long, open at both ends. The diameter of the upper opening is 15 cm. and that of the lower 10 cm., the pipe thus holding about 12 litres of water. M. Parmentier proposes pipes holding 20 litres for use in orchard irrigation. At Messina the upper end of the *catuso* projects slightly above the soil, the opening being covered with a brick or tile.

In the summer of 1889, at Portici, near Naples, I experimented on two lemon-trees of the same age and size, watering one in the usual manner and the other by means of a drain-pipe sunk vertically in the earth. During that hot summer, in the sandy, volcanic soil at the foot of Vesuvius, the difference between the effects of the two methods of watering was very apparent. The lemon-tree provided with the vertical drainage-pipe prospered on a ration of water about 50 per cent. less than that necessary for the control tree watered from the surface.

The sunk end of the drainage-pipe is made to rest on loose stones or potsherds, which form air-chambers. Thus clogging of the pipe is prevented, and the water that is poured down gets well absorbed and distributed just where the roots are more vigorously developing and renovating their absorbing organs.

The subsoil air-chamber is as important as the water-pipe. During drought the deep aeration of the soil, when moisture is sufficient, provokes the growth of the roots and the renewing of the root-hairs, increasing their power of absorption and at the same time favouring deep-soil nitrification. The roots are induced to develop chiefly around the reservoir of moist, warm air, where respiration and growth find favourable conditions, the network of young and active rootlets thickening around the spot where the watering is concentrated and nitrates are being actively formed. The loss by evaporation and percolation is minimised. Moreover, the close air under the foliage of the trees, as M. Parmentier remarks, is maintained in a less damp condition than is usual in the deeply shaded citrus orchards, where the development of parasites and pests is much favoured by the moist shade.

M. Parmentier observed that vegetables watered by underground irrigation are more tender and of higher market value than vegetables watered by submersion, or by any other method by which the foliage, stalks, and upper parts of the roots are wetted. Indeed, it may be added that the wetting of the foliage increases transpiration, and consequently the waste of water.

By means of vertical-pipe irrigation dilute liquid manure can be applied far more effectually and economically than by the usual method of night-soil manuring. In the case of vegetables and fruit-trees subsoil liquid manuring is also advisable from a sanitary point of view.

In arid climates, and wherever the economy both of water and of liquid nitrogenous manure is of special consequence, the Messina and Parmentier method of underground watering by vertical drainage is much to be recommended.

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New Sources of Aluminium.

I WAS much interested in the account given in NATURE of October 23 of the new methods of extraction of aluminium from clays of the kaolin class (formed from the denudation of volcanic rocks) by means of nitric acid and electric furnaces in Norway. When this source of production is generally adopted, as no doubt it will be owing to the diminishing supplies of cryolite and bauxite, it seems probable that the vast quantities of "decomposed porphyry" discovered by the late Prof. Jacob during his geological explorations in the Rocky Mountains (some of which have been mistaken for chalk by prospectors) will then form an inexhaustible source of supply for that valuable metal.

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Radiation Temperature: Dew.

THE letter in NATURE of October 23 on radiation temperature from Mr. Spencer Pickering reminds me that the theory of the equilibrium temperature is given by Clerk Maxwell in his little-known article on Diffusion ("Ency. Brit.," ninth edition, p. 218). Maxwell shows that in still-air temperature θ_0 a thermometer will gain heat per sec. $4\pi CK(\theta_0-\theta_1)$, where C is the electrical capacity of the bulb, K the conductivity constant for air; and that it will give up heat per sec. $AR(\theta_1-\theta)$, where A is the area of the bulb, R the radiation constant, and θ the temperature towards which radiation occurs. If the bulb be spherical $C=r$, its radius. Consequently,

$$4\pi rK(\theta_0-\theta_1)=4\pi r^2R(\theta_1-\theta),$$

or

$$K(\theta_0-\theta_1)=rR(\theta_1-\theta).$$

That is, the conductivity effect depends on the radius of the bulb. Mr. Pickering has observed this in the case of small bulbs. He goes on to apply this result to small objects, such as the pistils and stamens of flowers. I would like to point out another effect to which his observations apply, namely, that true dew (arising from radiation) is not found on spiders' webs. If webs are examined when dew is on the ground they are found to be dry. When drops of water are found they arise from the collecting action of the webs on mist or fog, *i.e.* by the collection of drops already formed. I have confirmed this on many occasions. I conclude that whenever drops are found on webs it is the result of fog or mist.

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