near Altoona, and in New Jersey on the seashore. In the latter location the animal had availed itself of the building-material at hand by forming the foundation of its watch-tower of little quartz pebbles, sometimes producing a structure of considerable beauty. In this sandy site the tube is preserved intact by a delicate secretion of silk, to which the particles of sand adhere. This secretion scarcely presents the character of a web-lining, but has sufficient consistency to hold aloft a frail cylinder of sand when it is carefully freed from its surroundings. A nest recently obtained from Vineland, N.J., furnished an interesting illustration of the power of these araneids to intelligently adapt themselves to varying surroundings, and to take advantage of circumstances with which they certainly could not have been previously familiar. In order to preserve the nest with a view to study the life-history of its occupant, the sod containing the tube had been carefully dug up, and the upper and lower openings plugged with cotton. Upon the arrival of the nest in Philadelphia, the plug guarding the entrance had been removed; but the other had been forgotten, and allowed to remain. The spider, which still inhabited the tube, immediately began removing the cotton at the lower portion, and cast some of it out. Guided, however, apparently by its sense of touch, to the knowledge that the soft fibres of the cotton would be an excellent material with which to line the tube, she speedily began putting it to that use, and had soon spread a soft smooth layer over the inner surface and around the opening. The nest in this condition was exhibited, and showed the interior to be padded for about four inches from the summit of the tower. The very manifest inference was drawn, that the spider must for the first time have come in contact with such a material as cotton, and had immediately utilized its new experience by substituting the soft fibre for the ordinary silken lining, or by adding it thereto.

## *LETTERS TO THE EDITOR.*

### Equations of third degree.

THE second or third terms of any equation may be made to disappear, and we may therefore assume

$$x^3 + Ax^2 + B = 0; \qquad (1)$$

and the solution of this equation must involve the general solution of cubics. Assume

$$x = y^{\frac{2}{3}} - y^{\frac{1}{3}}z^{\frac{1}{3}} + z^{\frac{2}{3}}. \qquad (2)$$

Hence

$$y^{\frac{1}{3}} = \sqrt{x - \tfrac{3}{4}z^{\frac{2}{3}}} + \tfrac{1}{2}z^{\frac{1}{3}}.$$

$$y = \sqrt[\frac{3}{2}]{x - \tfrac{3}{4}z^{\frac{2}{3}}} + \tfrac{3}{2}xz^{\frac{1}{3}} - z + \tfrac{3}{4}z^{\frac{2}{3}}\sqrt{x - \tfrac{3}{4}z^{\frac{2}{3}}}.$$

$$y + z - \tfrac{3}{2}xz^{\frac{1}{3}} = \sqrt[\frac{3}{2}]{x - \tfrac{3}{4}z^{\frac{2}{3}}} + \tfrac{3}{4}z^{\frac{2}{3}}\sqrt{x - \tfrac{3}{4}z^{\frac{2}{3}}}.$$

$$z^{\frac{2}{3}} - \frac{y+z}{x}z^{\frac{1}{3}} = \frac{x^3 - (y+z)^2}{3x^2}.$$

$$z^{\frac{1}{3}} = \sqrt{\frac{4x^3 - (y+z)^2}{12x^2}} + \frac{y+z}{2x}.$$

$$z = \sqrt[\frac{3}{2}]{\frac{4x^3 - (y+z)^2}{12x^2}} + \frac{y+z}{2} + \frac{3(y+z)^2}{4x^2}\sqrt{\frac{4x^3 - (y+z)^2}{12x^2}}.$$

$$432x^6(z-y)^2 =$$
$$64x^9 + 240x^6(y+z)^2 + 192x^3(y+z)^4 - 64(y+z)^6.$$

$$x^9 - 3x^6(y+z)^2 + 3x^3(y+z)^4 - (y+z)^6 = -27zyx^6.$$

$$x^3 + 3\sqrt[3]{zy}\,x^2 - (y+z)^2 = 0. \qquad (3)$$

In (1) and (3), equating coefficients,

$$3\sqrt[3]{zy} = A, \quad zy = \frac{A^3}{27}. \qquad (4)$$

$$-(y+z)^2 = B, \quad y^2 + 2yz + z^2 = -B. \qquad (5)$$

Whence, from (4) and (5),

$$y = \sqrt{-\frac{B}{4}} + \sqrt{-\frac{B}{4} - \frac{A^3}{27}}.$$

$$z = \sqrt{-\frac{B}{4}} - \sqrt{-\frac{B}{4} - \frac{A^3}{27}}.$$

Substituting these values of $y$ and $z$ in (2),

$$x = \sqrt[\frac{2}{3}]{\sqrt{-\frac{B}{4}} + \sqrt{-\frac{B}{4} - \frac{A^3}{27}}} - \frac{A}{3} + \sqrt[\frac{2}{3}]{\sqrt{-\frac{B}{4}} - \sqrt{-\frac{B}{4} - \frac{A^3}{27}}}, \qquad \text{formula } (a)$$

or

$$x = -\sqrt[3]{\frac{B}{2} + \frac{A^3}{27} - \sqrt{\frac{B^2}{4} + \frac{A^3B}{27}}} - \frac{A}{3} - \sqrt[3]{\frac{B}{2} + \frac{A^3}{27} + \sqrt{\frac{B^2}{4} + \frac{A^3B}{27}}}. \qquad \text{formula } (b)$$

In the case of the irreducible case of formula ($b$), which is similar to Cardan's formula, formula ($a$) may be used. In such case, only one part, as $\sqrt{-\frac{B}{4}}$, of formula ($a$) is imaginary, and $\sqrt{-\frac{B}{4} - \frac{A^3}{27}}$ is real; and if the signs of the roots of equation (1) be changed, which is done by changing simultaneously the signs of $A$ and $B$ in equation (1), the converse is true, that is, $\sqrt{-\frac{B}{4}}$ is real, and $\sqrt{-\frac{B}{4} - \frac{A^3}{27}}$ is imaginary. Which shall be the imaginary term is, then, arbitrarily chosen. Hence, factoring preparatory to expansion by the binomial theorem, the coefficient of $\sqrt{-1}$ may be made less than unity when the real term is unity.

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### Solar constant.

It is feared that the letter of Mr. Hazen (SCIENCE, i. 542) in relation to above topic may not entirely remove the confusion of which he justly complains. It should be premised that there are two units of heat in common use among physicists: the smaller being the quantity of heat required to raise the temperature of one gram of water 1° C.; the larger, the quantity of heat required to raise the temperature of one kilogram of water 1° C. The larger of these units is a thousand times as great as the smaller; and, in ordinary applications, no confusion is liable to arise. In either case, the number of units of heat received by the unit-mass of water is (sensibly) proportional to the number of degrees of rise of temperature.

With regard to the 'solar constant,' two additional units are required, — a unit of surface, and a unit of time. This constant may be defined in general terms