

composed of 4 hydrogen atoms and 2 negative electrons, then vanadium should have 51 hydrogen atoms and somewhere about 34 negative electrons.

The elements beryllium, neon, magnesium, silicon, chlorine, and argon do not seem to come properly in the curve. If their atomic weights have been correctly determined, then there must be something peculiar about these elements.

I have also drawn a curve from the atomic weights as given in Bloxam's "Chemistry," hydrogen being taken as 1, and have produced a similar curve to the one given here, except that the latter part does not rise so steeply.

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Chemical Warfare and Scientific Workers.

LIKE Prof. Soddy (NATURE, November 4, p. 310), I have received an invitation from the War Office to become an associate member of the "peace" organisation which is to "develop to the utmost extent the offensive and defensive aspects of chemical warfare." I have had enough practical experience of the experimental side of chemical warfare to know what it involves, and I have without any hesitation refused to join the new Committee.

In the first place, the project is simply wicked. Education stands for something more than the acquisition of knowledge, and if at the present time I lent any support to the activities of the Committee I feel that I should necessarily be quite unfit to take any part in the training of young minds. To do what I can to promote in everyone the faith that war is done with has become part of my business because it is the world's business. In the second place, the project is futile. No real progress will be made in discovering new methods of offensive chemical warfare except by people who have their heart in it; perfunctory adhesion to an official organisation will discover nothing worth knowing.

Is any intelligent person—and only intelligent people would be of any use in this very complicated subject—at this point in the world's progress going really to put his heart into the search for methods of killing other people? I think not, even in the case of professional soldiers. Some may comfort themselves with the idea that they will escape the moral difficulty by engaging only with defensive methods. This will be equally futile, for adequate defence can only follow discoveries on the offensive side; it cannot precede them. It is impossible to devise protection against offensive agents which are unknown, just as on the medical side it is impossible to work out methods for the cure of lesions of an unknown nature. The only effective preventions and cures which can be devised are ethical, and a War Office Committee is not quite the best atmosphere for that.

It may be extravagant to expect that all civilians will refuse to support this part of our "peace organisation," but I hope they will.

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October 5.

Testing Einstein's Shift of Spectral Lines.

A WORD of caution may not be amiss in respect of the suggestion made by Sir Oliver Lodge in NATURE of October 28, p. 280. The rotational stresses in the disc, though very large, may not portend immediate dissolution in steel, but what of the glass (?) of the vacuum tubes? The stresses, like the gravitational effect, increase as the square of the angular velocity. The method would seem well calculated to develop pleochroic effects in glass.

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October 30.

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Contractile Vacuoles.

CONTRACTILE vacuoles are found only in those cells which lack a continuous cell-wall. This appeared to suggest that the function of the contractile vacuole is to eliminate dissolved crystalloids and so to keep down the osmotic pressure distending the semi-permeable protoplasm. Otherwise the latter, lacking the support which a continuous cell-wall gives, would continue to stretch and would finally rupture.

There is, however, another, and possibly more plausible, point of view, namely, that the contractile vacuole is, in point of fact, this rupture. Suppose a small accumulation of a soluble crystalloid in a semi-permeable gel which exhibits slight elasticity and slight tenacity—qualities which the protoplasm of the cell appears to possess. The osmotic pressure of the crystalloid will push back the protoplasm, overcoming its rigidity. Thus a cavity is formed which enlarges as water flows into it. Expansion will proceed until but a very thin film of protoplasm separates the solution from the surrounding water. Later expansion causes continued thinning of the film until its tenacity suddenly gives way, and the solution contained in the vacuole becomes, through the rupture, continuous with the surrounding water. The elasticity of the protoplasm now asserts itself, and the walls of the cavity are driven together. The semi-fluid, viscid constituents of the protoplasm secure the healing up of the rupture and the obliteration of the cavity, while the viscosity of the surrounding substance leads to a delay in recovery marked by the appearance of the radiating canals.

Thus we may look upon a contractile vacuole, not as an organ of a cell, but rather as the effect of the local accumulation of any soluble substance. In fresh-water naked protoplasmic organisms the formation of a cavity surrounding this accumulation and the periodic forcible ejection of some of the solution are rendered inevitable by the physical properties of protoplasm. When once a cell acquires a complete cell-wall, the protoplasmic film receives sufficient support and the vacuoles become permanent.

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October 22.

Visibility of the Landscape during Rain.

ON a recent visit to the mountains of North Wales the writer was impressed with the variations in the visibility of the landscape when rain was falling. In the lower valleys a storm which may be sufficient to wet thick clothing through in a few moments may leave the contours of the mountains quite distinct at several miles distance. On the other hand, a mountain drizzle or "Scotch mist" may render everything invisible at a few yards. An elementary treatment of the subject brings out one or two points of interest.

Let it be assumed that the raindrops are perfectly opaque and that the atmosphere is otherwise perfectly transparent, both assumptions being, in general, close approximations to the actual state of affairs.

Consider a heavy rainstorm during which rain falls at the rate of 1 cm. per hour, or 0.00028 cm. per second. The raindrops appear to be most often of 1 to 2 mm. diameter. Taking the lower value (1 mm.), the volume of the drop is 0.5×10^{-8} c.c.

According to Stokes's law

$$v = \frac{2r^2(\rho - \rho_1)g}{9\eta}$$

and at 15° C., η , the viscosity of air, is 181×10^{-8} , so that $v = 3000$ cm. per sec.

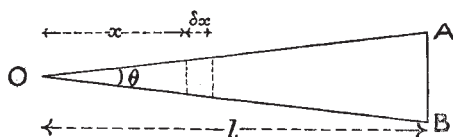
Consequently, the depth of water which falls in

one second (0.00028 cm.) is spread while falling over a vertical column of air 3000 cm. high.

There is, therefore, 1 c.c. of water in about 10^7 c.c. of air, or 1 raindrop in every 5 litres or so (1)

Now, in the state of maximum disorder (the "most probable" state) the raindrops will be spaced equally in all directions, vertically as well as horizontally, and the average distance between two spots will be

$$\sqrt[3]{5000} = 17 \text{ cm.} \quad \dots \dots (2)$$



Consider a circle of landscape, of diameter AB, subtending an angle θ at the observer at O, distant l from AB. $AB = l\theta$.

A spot of rain at x is projected against the background as a disc of diameter

$$\frac{l \cdot d}{x}$$

(d being the diameter of the spot) and blots out an area

$$\frac{\pi (ld)^2}{4x^2}$$

If n denotes the number of rain spots in unit volume of air, then in the element ∂x of the cone in the figure there are

$$n \cdot \frac{\pi (x \cdot \theta)^2 \partial x}{4}$$

and these, projected on the background, blot out an area

$$n \left(\frac{\pi x \cdot \theta \cdot ld}{4x} \right)^2 \partial x,$$

or

$$n \frac{\pi}{4} \cdot d^2 \partial x \times \frac{\pi (l \cdot \theta)^2}{4},$$

or

$$n \frac{\pi}{4} \cdot d^2 \cdot \partial x \times \text{Area of background} \quad (3)$$

Hence each element ∂x contributes the same amount of blotting-out of the landscape, the larger apparent diameter of the nearer spots being compensated by their smaller numbers, and the visibility of the landscape falls off as a linear function of the distance.

The total area blotted out is the integral of (3),

$$\text{i.e. } \frac{\text{Area of projected rain spots}}{\text{Area of landscape}} = n l \left(\frac{\pi d^2}{4} \right),$$

and the landscape is entirely blotted out when the above ratio equals unity.

Putting

$$n = \frac{\text{Depth of rain falling per sec. (D)}}{\frac{\pi}{6} \cdot d^3 \cdot v}$$

in this equation, we get as the limiting distance at which the outlines of the landscape can be distinguished

$$l = \frac{2}{3} \frac{d \cdot v}{D} \quad \dots \dots (4)$$

Using the values suggested above, $d = 0.1$, $v = 3000$, and $D = 28 \times 10^{-5}$, the value of l comes out as 7 km., or $4\frac{1}{2}$ miles.

Thus a very heavy rainstorm may be remarkably transparent.

Let N = the number of spots falling per second on

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unit area ($N = n \cdot v$), then, combining equation (4) with Stokes's law, and calling $\frac{1}{l}$ the obscuring power of the storm, we have

$$\frac{1}{l} = \frac{9\pi}{4g} \cdot \eta \cdot N \quad (\text{since } \rho - \rho_1 = 1) \quad \dots (5)$$

That is, the obscuring power of a storm is simply proportional to the number of spots falling per second, or every raindrop has the same obscuring power, whether it be large or small and whether the total rainfall be heavy or light.

The very great obscuring power of a "Scotch mist" is thereby accounted for.

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Museums in Education.

IN NATURE of October 28 appeared a review of the Final Report of the Committee (British Association, Section L) on "Museums in Relation to Education," in which it was stated that "our great public schools have some excellent museums, but there is little or no evidence that they are used in school teaching." May I be allowed to point out that this sweeping indictment of incapacity or lack of imagination on the part of masters in public schools is not without exception?

The museum of natural history at Oundle School is, I suppose, fairly typical of such collections. It consists of specimens representative of zoology, botany, palæontology, and petrology. Owing to lack of space, not all the specimens can be exhibited with advantage, and the excess has been temporarily stored, so as to avoid detracting from the educational value of the exhibits, pending the erection of a more spacious building. The present museum, which is apart from the laboratories, is accessible at all times to all boys whether or not they are taking natural history subjects in the curriculum. The zoological collection forms an index to the animal kingdom; it consists of specimens representative of all the phyla and of a considerable number of classes. These are distinctly grouped and clearly labelled. In further amplification of this series a certain number of drawings, dissections, and skeletons, also clearly labelled, are interspersed among the types. This work has been carried out entirely by the boys, under supervision, and forms, therefore, an elementary introduction to research. There are also table-cases representative of protective coloration, insect pests, metamorphosis, etc. Owing to lack of time and space the botanical exhibition is not so far advanced, but there is a good collection of types of timber on view, while a collection representative of the dispersal of fruits and seeds is in the making. During the summer term the younger boys maintain a constant display of the flowering plants of the neighbourhood. (The lack of botanical exhibits in the museum is largely compensated for by a botanical garden comprising natural-order beds, a rock garden, a rose garden, marsh and aquatic flora, etc.) The palæontological collection consists of a series of wall-cases containing fossils arranged according to their strata. The petrological collection comprises table-cases illustrative of the more common rock-forming minerals, with a considerable number of good specimens clearly arranged and classified. For the two latter collections, as regards both material and arrangement, the school is indebted to the great kindness of Profs. Marr and Solly respectively.

More than three hundred boys (out of five hundred) are undergoing biological training at Oundle School