$k\frac{\delta t}{\delta p} \div \frac{dv}{dt}$ is the smaller of the two, and we proceed to find its value. We have as a first approximation to the behaviour of gases,

$$pv = C(1 + \alpha T),$$

where T is the temperature centigrade on a gas-thermometer.

We therefore have, as approximate equations,

$$v = \frac{C}{p}\left(1 + \alpha T\right),$$

$$\frac{dv}{dT} = \frac{C\alpha}{p}.$$

We may further assume that $\frac{dv}{dt} = \frac{dv}{dT}$, since the degrees are practically equal on the two scales.

We therefore obtain, approximately,

$$v = \frac{C}{p}\left(1 + \alpha T\right),$$

$$\frac{dv}{dt} = \frac{C\alpha}{p}.$$

Using these approximate values, we have

$$k\frac{\delta t}{\delta p} \div \frac{dv}{dt} = \frac{kp}{C\alpha}\frac{\delta t}{\delta p}$$

$$= \frac{k}{C\alpha}\frac{\delta t}{\delta \log p},$$

and the equation for t becomes

$$t = v \div \frac{dv}{dt} + \frac{k}{C\alpha}\frac{\delta t}{\delta \log p}.$$

If now, further, we use the approximate values of v and $\frac{dv}{dt}$ in the term $v \div \frac{dv}{dt}$, we shall obtain

$$t = \frac{1}{\alpha} + T + \frac{k}{C\alpha}\frac{\delta t}{\delta \log p}.$$

This is the formula usually given.

This method of working appears to me to be incorrect, for the following reason :—

In the equation

$$t = \left(v + k\frac{\delta t}{\delta p}\right) \div \frac{dv}{dt}$$

there are two terms on the right-hand side, one of which, $k\frac{\delta t}{\delta p} \div \frac{dv}{dt}$, is small compared with the other. We may therefore neglect it as a first approximation, and we then obtain $\frac{v}{t}$ = function of p, in accordance with the laws of a perfect gas. If we wish to proceed to a closer approximation, we may use the perfect-gas laws as sufficiently good in the term $k\frac{\delta t}{\delta p} \div \frac{dv}{dt}$, because that is a small term, and the departure of the actual gas from the perfect gaseous laws will consequently in this term introduce only errors which depend on the squares of small quantities. But we are not at liberty to use the perfect gas laws in the remaining term $v \div \frac{dv}{dt}$, because it is *not* a small quantity, and we have therefore no guarantee that the use of such an approximation will not introduce errors of the first order of small quantities—that is to say, comparable with the term $k\frac{\delta t}{\delta p} \div \frac{dv}{dt}$ itself. With such errors introduced, the second approximation would not necessarily be better than the first.

The mistake in principle, which I have indicated, appears to be widespread, since it has crept into several of our well-known text-books. Thus the discussions given in Tait's "Heat" (pp. 338–339), in Baynes' "Thermodynamics" (pp. 126–127), and in Maxwell's "Heat" (pp. 211–214), all appear to me infected by this source of error. It is true that in these discussions the mistake is introduced more subtly, and is covered with a mass of symbols; whereas in the faulty investigation given above, I have purposely made the paralogism as glaring as possible. But *in substance* the mistake occurs in each of the discussions above named. JOHN ROSE-INNES.

May 13.

Printer's Ink and Photographic Plates.

IN a paper on the action exerted by certain metals and other substances on a photographic plate, by Dr. W. J. Russell (*Proc. R.S.*, vol. lxi. p. 424), the author mentions that the *Westminster Gazette* is printed with an ink which readily acts on a photographic plate. The printed paper in some experiments is placed in contact with the photographic plate, in the dark, and after being left in contact for some time, in the dark, the plate is developed, and the printed letters come out clearly. Dr. Russell mentions the names of several periodicals the print of which acts on a sensitive plate. To these the following example of the same phenomenon may be added : a photographic plate wrapped up in an advertisement sheet of *Modern Society* on development showed the printed characters very clearly, the words reading from left to right, not being reversed, so that the action must have taken place through the thickness of the paper. This sample of the action of printer's ink on a photographic plate (the property of Mr. W. B. Croft) has been in the excellent physical laboratory museum at Winchester since 1892. The print is good and clear, and probably one of the earliest observed instances of the action of printer's ink on a photographic plate in the dark, in which the physical conditions were known and recorded. F. J. JERVIS-SMITH.

Oxford, May 16.

Heavy Rainfalls.

I THINK it worthy of record that at a place called Nedunkeni, in the Northern Province of Ceylon, the rainfall on December 15–16, 1897 (24 hours), was 31·76 inches. The average annual rainfall of this place was 64·70, but in 1897 the amount totalled 121·85 inches.

The heaviest recorded rainfalls (as given in the "Encyclop. Britt.") are at Joyeuse, France, 31·17 inches in 22 hours ; at Genoa, 30·00 inches in 26 hours ; at Gibraltar, 33·00 inches in 26 hours ; on the hills above Bombay, 24 inches in one night ; and on the Khasia Hills, India, 30·00 inches on each of five successive days.

The rainfall in Ceylon, referred to above, is therefore notable. The greatest annual rainfall occurs, as is well known, on the Khasia Hills, with 600 inches. The wettest station in Ceylon is Padupola, in the Central Province, with 230·85 inches (mean of 26 years), the rainfall for last year being 243·07 inches. C. DRIEBERG.

School of Agriculture, Colombo, Ceylon.

Hermaphroditism in the Apodidæ.

I AM not sure but that the tone of Prof. Lankester's demand, in NATURE of May 12, that I should "at once" withdraw my "assertions," or confirm them by "some evidence," would not have justified my ignoring it altogether. For those of your readers, however, who may be interested in this subject, may I say that I *have* produced "some evidence" (*Ann. and Mag. Nat. History*, xvii., 1896, plates xi. and xii.), and no counter evidence whatever has yet been forthcoming to shake my faith in the justness of my conclusions. HENRY BERNARD.

Streatham, May 17.

MAGNETISM AND SUN-SPOTS.

WHEN Sir Edward Sabine was preparing his paper[1] "On Periodical Laws discoverable in the mean effects of the larger Magnetic Disturbances—No. ii.," in which he discussed the magnetic observations made at the temporarily established Colonial observatories at Toronto and Hobarton, he found that there existed at these places, in the years 1843 to 1848, a progressive increase in amount both of magnetic disturbance and in extent of diurnal range of the declination magnet, the values of diurnal range for the year 1843 having become in 1848 increased by some 40 per cent., the Toronto values for these years being 8′·90 and 12′·11 respectively, and the Hobarton values 7′·66 and 10′·63. This was an altogether unlooked-for result, one that engaged his special attention, such increase of value from year to year

[1] Read before the Royal Society, May 6, 1852.