generate other ions by collisions with the molecules of the gas when they move sufficiently rapidly.

(*b*) For any gas the negative ions which are generated by collisions are the same (having the same properties over wide ranges of force and pressure) as those which were generated by the rays.

(*c*) If α is the number of negative ions generated in a gas by one of these negative ions moving through one centimetre, then $\alpha = p f\left(\dfrac{X}{p}\right)$, where p is the pressure of the gas and X the electric force acting on the ion.

(*d*) The free paths of the negative ions are long, compared with the free paths of the molecules, so that their linear dimensions must be smaller than those of the molecules.

From a comparison of the properties of positive and negative ions, it can be seen that the mass of the negative ion must be small compared with that of the positive ion.

The values of α were determined for large ranges of pressure and electric force for air, carbonic acid and hydrogen, and the functions f have been represented graphically by three curves. Let f_1, f_2 and f_3 denote the functions f found for air, carbonic acid and hydrogen respectively as determined by the experiments with Röntgen rays.

The results which I have to add to these were obtained by finding the conductivities of gases between parallel plates when one of the plates is illuminated by ultra-violet light.

The experiments have led to the following conclusions :—

(*a'*) The negative ions set free from a zinc plate when ultra-violet light falls on it generate other ions by collisions with molecules of air, carbonic acid or hydrogen.

(*b'*) The negative ions thus generated by collision in the gases have the same properties (over large ranges of pressure and electric force) as the ions generated by the light from the zinc.

[Hence these four kinds of ions are identical, viz., the ions given off from the zinc plate and the negative ions which they produce in air, carbonic acid or hydrogen. These negative ions may be denoted by the letter Z.]

(*c'*) If α' is the number of ions which one of the Z ions produces per centimetre by collisions with molecules, then α' is connected with the electric force and the pressure by an equation of the form $\alpha' = p f\left(\dfrac{X}{p}\right)$. The three functions f_1', f_2', f_3' as determined in this manner for air, carbonic acid and hydrogen are equal respectively to the corresponding functions f_1, f_2, f_3 as determined by the experiments with Röntgen rays. The equality extends over the whole ranges of pressures and force which have been examined.

Consequently the negative ions generated by Röntgen rays in a gas are precisely the same as the ions set free from a zinc plate by ultra-violet light.

If it be questioned that the identities $f_1 \equiv f_1'$; $f_2 \equiv f_2'$; $f_3 \equiv f_3'$ are sufficient to justify this conclusion we may proceed to establish the proposition in the following manner :—

The charges on negative ions produced by Röntgen rays in any of the gases under consideration have been shown to be equal to the charge on a negative ion given off from a zinc plate by ultra-violet light (J. S. Townsend, *Phil. Trans.* 1899 and 1900).

For simplicity, one of the gases may be considered, air, for example. Let m be the mass and e the charge on a negative ion R produced in air by Röntgen rays, and let m' and e' be similar quantities for an ion Z produced by the aid of ultra-violet light.

Since the maximum values of f_1 and f_1' as determined by the larger values of $\dfrac{X}{p}$ are equal the two kinds of ions R and Z must produce the same number of collisions per centimetre so that they have the same free paths. For any force X, the kinetic energy that the R and Z ions acquire along their free paths must be equal since their charges are equal. At the end of a path of length x the value of $\dfrac{mv^2}{2}$ or $\dfrac{mv'^2}{2}$ is equal to Xex.

Hence we have the equation $mv^2 = m'v'^2$, v and v' being the velocities of the ions R and Z before collision.

A second independent equation is obtained when we consider the identity $f_1 \equiv f_1'$.

The chance of producing new ions by collision is not determined by the energy of the colliding ion. If this were the case, the positive ions would produce others by collision under an electric force X if their mean paths became equal to the

mean paths of the negative ions when they generate others under the action of the force X. It is easy to show that the positive ions do not acquire the property of producing others by collision even when their free paths are much longer than those of the negative ions when they are giving others by collisions. The negative ions therefore possess this ionising property in virtue of the large velocities they acquire along their free paths. It is therefore evident that the function f involves the mass and velocity of the colliding ion in some form which is not reducible to the product $m \times v^2$. The equality of f_1 and f_1' for the same values of e, X and p supplies us with an equation between m, v, m', v', of the form $\phi(m, v) = \phi(m', v')$. Combining this equation with the equation $mv^2 = m'v'^2$, we see that $m = m'$ and $v = v'$.

Hence the masses of the two ions R and Z are the same as well as their free paths and charges. We thus see that it is possible, by various methods, to detach negatively charged particles from the molecules of gases which are small compared with the molecules, and that the particles which are detached are the same from whatever gas they are removed.

JOHN S. TOWNSEND.

New College, Oxford, February 28.

The Recent Fall of Red Dust.

SOME observations made last autumn in Cornwall may throw light on the fall of dust in South Wales. On September 2, during gusty weather with squalls from the E.N.E., I watched from my window at Carbis Bay (270 feet above the sea) puffs and swirls of dust rising from the desert-like flat at the mouth of the Red River. The dust-cloud rose above the top of Godrevy Towans (230 feet), nearly blotted out Godrevy Lighthouse and then spread in a well-defined belt across St. Ives Bay for more than three miles to near St. Ives Head; which it must have passed, though this part of the track was invisible from my point of view. A fortnight earlier a similar observation had been made under identical conditions by Mrs. Reid. On neither occasion did the wind reach the force of a gale, it was merely a strong, dry east wind.

The red mud which gives its name to the Red River is mainly slime produced by the crushing of the tin-ore in the stream-tin works. This mud spreads far and wide over the alluvial flats and along the sandy shore ; when it dries it forms an almost impalpable dust. Much of this dust is mixed with the Cornish sand-dunes, and drifts to and fro with the shelly sand, which forms the main part of those dunes. If the dust-falls in South Wales are of Cornish origin, the material will probably contain a good deal of finely powdered schorl, which mineral occurs abundantly in the tin-ore.   CLEMENT REID.

The Validity of the Ionisation Theory.

THE number of NATURE which appeared on January 30 contains an abstract of a paper by L. Kahlenberg entitled "The Theory of Electrolytic Dissociation as viewed in the Light of Facts recently Ascertained." In the paper referred to is a kind of summary of observations which have been made on non-aqueous solutions, from the consideration of which the author draws the conclusion that the electrolytic dissociation theory is untenable in the case of non-aqueous solutions.

In view, however, of the generally accepted opinion that this theory is in good accordance with experimental observations on aqueous solutions, Kahlenberg has been led to investigate such solutions more closely. As the result of a large number of boiling-point, freezing-point and conductivity determinations, the conclusion is drawn that "the difficulties which the theory of electrolytic dissociation encounters in explaining the phenomena in aqueous solutions are really insurmountable."

One of the chief reasons for this inference appears to be that the series of molecular weight values calculated from the cryoscopic and ebullioscopic measurements at different concentrations of the solutions are irregular. As an example, it is found that in the case of solutions of magnesium sulphate, the calculated molecular weight, which even in the most dilute solution is greater than the theoretical value, increases at first with the concentration, passes through a maximum and then decreases, attaining a value which would correspond to electrolytic dissociation only in the most concentrated solutions. The author does not state in what manner these "molecular