failure to detect any charging effect, as a result of the influx of corpuscles, in the case of a mass of insulated metal surrounded by a thin metal shield to protect it from the potential gradient. The second arises from the fact that, in so far as the replenishment of the earth's charge requires the entry of 1500 corpuscles per sq. cm. per second, and, a corpuscle moving with a velocity approximating that of light produces about 40 ions in each centimetre of its path, we should expect a rate of production of 60,000 ions per c.c. per second. Experiment reveals a rate of production of less than 10 ions per c.c. per second, and these are attributable, for the most part, to known causes.

As regards the former difficulty, experiments to detect the charging effect were made by the writer in 1915, and more recently by von Schweidler, without finding any such effect. Unless we assume corpuscular ranges so great that there is negligible absorption in the test body, this result opposes any theory which invokes corpuscles shot into the earth from regions outside our atmosphere, or from the atmosphere itself as a result of direct spontaneous disintegration. The experiment is not so much in conflict with theory in the case where the corpuscles are emitted by the penetrating radiation, however. If the penetrating radiation is sufficiently hard to pass through the test body without appreciable absorption, it can be shown that it will eject as many corpuscles from the lower side of the body as it injects on the upper side.

Serious as the difficulty concerned with the ionising action of the corpuscles seems at first sight, there is a natural way of avoiding it, providing that we assume the corpuscles to have velocities so closely approximating the velocity of light that their tubes of force become crowded very greatly towards the equatorial plane. In these circumstances, if a corpuscle [2] is to give even a small finite amount of energy to an electron in the process of ejecting it from an atom, it must give it in an infinitesimal time, and such a phenomenon would require the payment of an infinite tax in the form of energy radiated. A full consideration of the details of the action shows that the reaction on the electron, due to its radiation, is such that, for any ionisation potential of the atom, there is a velocity sufficiently near to that of light, such that a corpuscle having that velocity would be unable to produce any ionisation in the gas.

The ionisation potential of oxygen, which is less than that of nitrogen, is 15·5 volts, and on the classical theory of electrodynamics a corpuscle would fail to ionise oxygen or nitrogen for all velocities in excess of 200 metres per second below the velocity of light. It may be of interest to remark that, in order that an electron should strike down into our atmosphere in the vicinity of the equator and reach the earth's surface, without being bent back by the earth's magnetic field, it would have to possess a velocity nearer to that of light than the above value, so that the very fact that it could reach the earth would be sufficient to ensure that it would not ionise on the way. Moreover, as another illustration of the same principle, it may be remarked that the above value for the velocity lies between the two limits, 400 metres per second less than that of light, and 4 metres per second less than that of light, assigned by Birkeland as the limits between which the velocities of negative electrons from the sun must lie in order that they shall be capable of accounting for the aurora. Of course, failure to ionise would prevent corpuscles from functioning as regards the aurora, and the figures in question are only cited for their general interest. There are other reasons for believing that the aurora is not caused by negative electrons.

Once we assume these high energies for the corpuscles, they carry with them the possibility of very great penetration, as may be shown from a consideration of the circumstances which determine absorption in the atmosphere. This penetrating power is enhanced by the diminution of the power of the corpuscles to communicate energy to the electrons by which they pass. Thus, while, as regards the mere explanation of the earth's charge, we may avoid the assumption of long ranges, as in the theory which invokes the penetrating radiation to eject the corpuscles from the air, we find it necessary to postulate, for the corpuscles, velocities closely approximating the velocity of light, in order to explain the absence of ionisation, and this of itself implies long range as a consequence.

(*To be continued.*)

[2] The word "corpuscle" is merely used to distinguish the high-speed electron, the ionising powers of which are under discussion, from the electron in the atom.

The Royal Academy, 1923.

THE private view of this year's Exhibition of the Royal Academy took place on Friday, May 4. The juxtaposition of the Royal Society and the Royal Academy suggests something deeper than the accident of both being dependent upon the patronage of the wealthy and the hospitality of the State. On either side of the wall that separates the academies of art and science the work is alike also in this—the impulse of the worker is to represent and thereby to preserve the visions that he has seen, that others might have seen if they had been gifted with the insight that sees things hidden from the rest of the world by the blinding candour of Nature. One uses paint or clay, and the other the printing-press or the experimental table; and however dependent either may be on the smile of the wealthy or the favour of the potentate for the means to "carry on," the satisfaction of achievement in the effort to express what they alone have seen with the mind's eye redresses for either the adverse balance of many an account. A year's Proceedings of the Royal Society show what the fellows wish to hand on to posterity as expressing their searching into Nature: so the yearly exhibition at Burlington House represents the messages to which the artists of to-day have dedicated their power of insight.

Passing through the galleries for the first time one wonders what message the artist is trying to convey and whether he has succeeded. There can be little doubt that 200 (*Still Life*, by Meredith Frampton) aspired to give the impression of china ducks and flowers, and has succeeded; and the same may be

said of an impressive study of huge Atlantic waves close at hand, with a tiny ship in the background, 558 (*Henry Hudson, 1607*, by Norman Wilkinson); but what the message is in 15 (*Little Dancer*, by Glyn Philpot) is less obvious: it is perhaps the beauty of gradations of subdued colour. So also the piece by the same artist, 170 (*Penelope*), and 34 (*Youth*, by F. Cayley Robinson), and in a drab monotonous way 155 (*Hayling Island*, by Oliver Hall). There are others, on the contrary, who use vigorous contrasts instead of gentle gradations. Such are 36 (*Rocks, Tregiffran*, by Robert M. Hughes), 53 (*Sennen Beach*, by Laura Knight), and 234 (*Wiltshire Downs*, by Edward Buttar), and even more impressive as an appeal to the sense of beauty of colour, saffron with blue shadows and pink sky, 151 (*An Autumn Evening in the Western Highlands*, by Adrian Stokes), and 264 (*Seagulls Nesting*, by Charles Simpson), a vision of the colours of spring. Not always satisfying are these schemes; 366 (*Sons of the Sea: Polperro, Cornwall*, by John R. Reid) makes one think of the artist's colourman rather than Nature's beauty.

One of the striking features of the pictures by the well-known artists is the sensation of vivid illumination. Marked discontinuities of light and shade give the effect, obviously desired, in 25 (*Ariñez on the Battlefield of Vitoria, Spain*, by James P. Beadle), 72 (*Glebe Place, Chelsea, 1922*, by George Henry), 175 (*Lovers of the Sun*, by H. S. Tuke), 278 (*Market Jew: Thursday*, by Stanhope A. Forbes), and 174 (*An Italian Lemon Garden*, by H. H. La Thangue): in the last the discontinuities are perhaps too strong for real pleasure. There is a wonderful sense of luminosity from discontinuity of colour alone without very marked shadows in another picture by the same artist, *The Mill Stream* (64), and also in 336 (*The Finish*, by Harry Fidler).

A juxtaposition of colours that one may call iridescence is artfully used to convey the sensation of local luminosity in 126 (*Golden Summer, Cornish Coast*, by Julius Olsson), and 191 (*Surf-bound Shore*, by the same artist), and 565 (*The Coastwise Lights*, by Harry Van der Weyden); also, but less successfully, for the illumination of the misty atmosphere of a setting sun of vast dimensions in 379 (*The Fading Day*, by Fred Hall). Some artists boldly paint a parti-coloured background and let the spectator regard it as sky if he please. That is noticeable in the colour scheme of 19 (*The Trojan Women*, by Charles Ricketts), in 226 (*The Sons of Ellis Hajim, Esq.*, by Charles Sims), and 229 (*Brood Mares and Foals at Southcourt Stud*, by Alfred J. Munnings).

As a fellow-student of Nature one cannot but feel that the sky must be a very exasperating part of an artist's subject unless it is all blue, or all grey, or all pink. When there are clouds with definite shape and movement the representation of Nature's varying mood is very difficult. The natural sky, even when it is most complex, is not chaotic; it has lines and touches that suggest order, a horizontal alignment, a characteristic shape, the detail of an outline, but so subtle and so transient that, while the student is meditating its features, they are gone. Apparently only the more noted artists challenge the heavens with a presentation of this subtle order in disorder, and not with complete success. 137 (*Tilty Church*, by George Clausen) shows clouds of easily recognised shape, but lacking the characteristic detail of outline. The most successful skies succeed by evading the real problem. The beautiful picture of *The Port of London* (213), looked at from above, by W. L. Wyllie, makes an atmosphere of native smoke and excuses the sky. Almost the same artifice is used in another picture by the same artist, *A Storm is Coming* (217). Details are also avoided by a general "all-overishness" in 162 (*The Lowlands of Holland*), 310 (*In from the Sea*), both by Robert W. Allan, and 370 (*A Grey Sea*, by the Hon. Duff Tollemache), and in a beautiful Scottish snow picture (124) by Joseph Farquharson. The challenge is evaded in 236 (*Summer Morning, St. Ives*, by Charlton Fortune) by filling up the sky with seagulls; but it is deliberately taken up by Arnesby Brown in quite a number of pictures—3 (*September*), 79 (*The Swing Bridge*), 130 (*The Waiting Harvest*), 148 (*The Watch Tower*): the disorder is there patent, but the whisperings of order in a disordered sky are missing. No more successful in this respect are 178 (*A May Morning at Southcourt*, by A. J. Munnings), 203 (*The Mountain Stream*, by Lewis T. Gibb), 335 (*Dover and Castle from the North*, by Frank P. Freyburg).

There is a peculiarity about natural skies; without any effort one is conscious that one is watching either the plan of an extensive layer or the elevation or profile of individual clouds. It is only occasionally that one gets that sort of satisfaction out of a picture. It is very nearly complete in 207 ("*If the clouds be full of rain, they empty themselves upon the earth*," by Frank Walton), in a picture by R. Vicat Cole, and in 484 (*Tintagel*, by Algernon Talmage). One misses it in 199 (*The Blue Pool*, by the late Mark Fisher), and in 259 (*Before the Ruined Abbey*, by Sydney Lee). It has often been remarked that the Greeks and Romans had no names for the forms of clouds which we have learned to recognise so easily. The exhibition suggests that the reason lies very deeply set.

As one leaves the galleries the questions as to what message the artists meant to convey and whether they have succeeded recur. Among the pictures most satisfying in answering both questions at first sight we may name 47 (*The White Sands of Scilly*, by Julius Olsson), 124 ("*Some gleams of sunshine mid renewing storms*," by Joseph Farquharson), already mentioned, 333 (*Green-clad Hills, Lake of Annecy*, by Terrick Williams), and 636 (*Winter Evening, Engelthal*, by Adrian P. Allinson).

Judging from experience outside, one might have been afraid that the Academy of 1923 with its multitude of portraits would have been a nightmare of horn-rimmed spectacles: it is not so. There is only one specimen, *Portrait of the Painter*, by the late Sir J. J. Shannon. The pervading influence of the War has also passed away except in the sculpture rooms and in the satiric picture by Sir William Orpen.

Scientific worthies are not very conspicuous in the collection. There is a bronze bust of the late Dr. Ludwig Mond, and one of the late Sir James Dewar (by G. D. Macdougald); also a marble bust of Sir J. J. Thomson, by F. Derwent Wood, as well as the portrait by Fiddes Watt.