observer and the source of the scattered light which reaches him, by the absorption of the short waves by interposed water vapour and by the admixture of white light reflected from the larger particles.

The scattering to which we have been referring is evidently different from what we ordinarily mean by reflection; the latter assumes that the reflecting surfaces have an area large as compared with λ^2; whereas scattering assumes that the volume of the particle must be small as compared with λ^3.

Such is in outline the theory and the main facts in regard to the cause of blue sky light; but there are several secondary features which must be now considered. The sky is bluer in the zenith than elsewhere, evidently because the path traversed by the scattered light is here the shortest, so that it suffers less admixture with white light and less absorption of blue light. Conversely it should be less blue near the horizon, and when the sun is low may take on a red or orange tint, as we know is the case. The light from the zenith is most intense when the sun is nearest it, as at true noon, and its blue is least pure at the hottest part of the day, on account of the maximum amount of large particles of dust and vapour constituting the haze existing at this time.

Arago discovered that there is a point, about 15° above the point diametrically opposite the sun (the antisolar point), where the polarisation is zero; between this and the horizon the polarisation is horizontal. Babinet discovered a similar point above the sun, and Brewster found one below it. Between the neutral points discovered by Babinet and by Brewster the polarisation is horizontal; below Brewster's point and above Babinet's it is vertical. For a little way on each side of the neutral points the plane of polarisation is inclined at about 45° to the vertical. This seemed to indicate that superposed upon the polarisation resulting from the scattering of direct sunlight is a horizontal polarisation due to some secondary cause. It was soon suggested that the horizontal polarisation is due to a secondary scattering of the light coming from the lower layers of the atmosphere, and this has generally, but not universally, been accepted as the most probable explanation. Other neutral points have been observed under rare conditions.

The positions of the neutral points, the amount of polarisation, the position of the point of maximum polarisation, as well as the colour of the sky, are intimately connected with other meteorological phenomena, but as yet the observations have been so meagre, made under such dissimilar conditions and by such various forms of apparatus, that it is nearly impossible to tell what is the true connection.

Cornu says—in words of which the following is a translation—"In a general way, the amount of polarised sky light is connected in so direct a manner with the condition of the atmosphere that I have been led to think that it is characteristic of the state of the atmosphere. The greatest clearness of the sky corresponds to the greatest amount of polarisation; cirrus and fog decrease the amount, and even completely destroy the polarisation when the sky is overcast. . . . What is particularly interesting is that the least change in the state of the atmosphere is plainly shown by the polarimeter several hours before other precursory phenomena (barometric variation, halos and various other optical phenomena) have begun to indicate a change.

"Under these conditions it would be useful to carry out these observations in a methodical manner, and to compare the polarimetric variations with other elements characteristic of the atmospheric condition. . . . The amount of polarisation increases as the sun sinks below the horizon until it reaches a certain maximum, after which the polarisation rapidly disappears. The law of this increase of polarisation with the time is very important, for it appears to me to give the vertical distribution of fog in the atmosphere; indeed, if the increase is rapid the lower layers are foggy and the upper ones transparent; if the increase is slow, the atmosphere is more homogeneous."

In short, the more fog or cloud there is present the less the amount of polarisation and the less pure is the blue of the sky.

The most extensive series of observations are those of Rubenson and of Brewster on the polarisation, and of Crova and Abney on the colour of the light from the sky. The first limited himself to observations made in fairly clear weather, and the second directed his attention principally to the determination of the positions of the various neutral points. Rubenson and most other observers have laid special stress upon the intensity of the polarisation at its maximum point in the vertical circle through the sun. This is undoubtedly the point where observations can be most easily taken, and those so obtained must be of great meteorological value; but the interpretation of them is rendered difficult by the variation in the length of the path of the scattered light at different times of the day. At sunrise and sunset the point observed is the zenith, and the path is a minimum; while at noon, if the observer be in the tropics, the point observed may be on the horizon, and the length of the path a maximum. For other positions on the surface of the earth the variation in length of path is less than this.

On the other hand, unless we observe a point of maximum polarisation the observations will be vitiated by every error in determining the position, with respect to the sun, of the point observed. Though other objections may be urged, it has occurred to me that for meteorological prediction the most valuable data would be obtained from continuous observations of the amount of the polarisation of the light from points of the sky on the horizon and 90° distant from the sun. These are points of maximum polarisation; these observations will give a kind of integration of the atmospheric conditions over a large area, and the length of path being the same at all times the observations should all be comparable, except for the varying angle of illumination of the surface of the earth, which, unless the nature of the surface differs greatly in different directions, I think would hardly affect the results appreciably, except, perhaps, when the sun is near the horizon. No one, to my knowledge, has carried out such a series of observations, hence the suggestion is advanced with great hesitation.

Since the colour of the sky is independent of the angular distance of the point observed from the sun, being a function of only the state of the atmosphere and the thickness of the stratum observed, there is but little choice in the altitude of the point where we make the colour observations. But since the blue is a maximum in the zenith this is rather to be preferred, for a slight error in the position of the point observed will here produce the least effect.

Whatever point or points are observed, the fact remains that careful observations on the colour and the polarisation of the light from the sky will give us data determining the amount and size of the particles floating in the air, be they dust or water, and, as any change in the state of the atmosphere will affect these quantities, such observations should be of ever-increasing importance to meteorology. First, however, we must have a long series of observations taken at different places and under all conditions, with exact meteorological data obtained at the same time and place, together with a description of the nature of the surrounding country. When these have been obtained it should be not very difficult to find means of using future observations with great success.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE Senate of the University of Dublin has decided to confer the honorary degree of D.Sc. upon Prof. W. Burnside, F.R.S., and Mr. W. E. Wilson, F.R.S.

ON Tuesday, June 18, Lord Avebury will open an exhibition of students' practical work, executed in connection with the technological examinations of the City and Guilds of London Institute, at the hall of the University of London.

THE Report of the Council of the City and Guilds of London Institute upon the work of the Institute during last year refers to a number of noteworthy matters. The Institute has been incorporated by Royal Charter, but the general constitution remains unchanged. The Central Technical College has become a School in the Faculty of Engineering of the University of London. The Departmental Committee appointed to consider "the best means for coordinating the technological work of the Board of Education with that at present carried on by other educational organisations" has had several meetings, and it is hoped that arrangements may be made for the more intimate association of the work of the Institute's Technological Examinations Department with that of the Board, by which the overlapping of examinations may be avoided and the instruction provided by county councils and technical schools may be brought into closer relationship with the Board of Education and the Institute. Referring to the extrance examination and the teaching of science in secondary schools, the Council remarks: "The Central Technical College is the only college of

the University in London which imposes such an entrance test for engineering, and unless and until the University is prepared to adapt its matriculation to suit the requirements of particular classes of students, which it is empowered to do under the new Statutes, and especially to engineering students, no very general or substantial improvement can be expected." Appended to the Report is an address given by Prof. Armstrong upon his retirement from the office of Dean of the College, his term having expired, and an address delivered by Sir Alexander R. Binnie at the opening of the current session. Both at the Central Technical College and at the Finsbury Technical College there was an increase in the number of students in the electrical departments, owing possibly to the development of electric traction in this country.

THE president of the Massachusetts Institute of Technology, in his annual report, records that there were in the Institute at the end of last year no less than 1277 students—the largest number yet reached. Of this number 193 were fourth-year students. The average age on entrance is eighteen years and ten months, which is a few months more than the average age at which students enter the Central Technical College, London. An increasing number of students remain for a fifth year or enter the Institute for post-graduate courses. There are thirteen courses extending over four years, and including such subjects as chemical engineering, sanitary engineering and electro-chemistry. In looking through the "Annual Catalogue" containing the outlines of the work done in these courses, we are reminded of the statement made in connection with the recent dismissals at the Royal Engineering College, Coopers Hill, that Indian engineers only need to know chemistry "to the extent required to enable the engineer to interpret results given by professional chemists." This is not the way in which engineers are trained at the best technical colleges in the United States, and if Lord George Hamilton and the Board of Visitors of Coopers Hill had seen the programmes of the engineering studies at the Massachusetts Institute they might have decided upon a more liberal action with regard to the subjects to be taught and the provision for teaching in a college where engineers are trained for the public service. The Faculty of the Massachusetts Institute has decided to discontinue the announcement of the degree of Doctor of Science, and to make the requirements for the degree of Doctor of Philosophy include "high attainments of a grade which qualifies the recipient as a scientific investigator and teacher." During 1900 the Institute received 100,000 dollars (less succession tax) under the will of the late Mr. R. C. Billings. The gift of 50,000 dollars by the late Mr. A. Lowell to constitute "The Teachers' Fund" has been increased to 100,000 by the executors, in conformity with his wishes. Other gifts received during the year amount to about 45,000 dollars. The total amount of the Institute property, both real and personal, was increased during the year by a net amount of 219,853 dollars, after deducting the sum of 8593 dollars, which is the excess of expenses over income.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 23.—"A Comparative Crystallographical Study of the Double Selenates of the Series $R_2M(SeO_4)_2,6H_2O$—Salts in which M is Magnesium." By A. E. Tutton, B.Sc., F.R.S.

This memoir on the magnesium group of double selenates, in which R is represented by potassium, rubidium and cæsium, is analogous to that which was presented to the Society in March 1900 concerning the zinc group.

The conclusions derived from the study of the morphological and physical properties of the crystals of the three salts are generally similar to those arrived at from the study of the zinc group. There is observed an uniform progression with regard to every property in accordance with the order of progression of the atomic weights of the three alkali metals present. That is to say, the constants of the rubidium salt are generally intermediate between those of the potassium and cæsium salts.

The magnesium group has, however, proved particularly interesting, inasmuch as the progressive diminution of double refraction, according to the rule which has now been established for this series of double sulphates and selenates, leads in the case of cæsium magnesium selenate to such close approximation of the three refractive indices that the crystals of this salt exhibit exceptional optical phenomena. This includes dispersion of the optic axes in crossed axial planes at the ordinary temperature, the uniaxial figure being produced for wave-length 466 in the blue; and the formation of the uniaxial figure for every wave-length of light in turn as the temperature is raised, the attainment of uniaxiality for red lithium light occurring at the temperature of 94°. As the life-history of the salt terminates at 100°, owing to the presence of water of crystallisation, this substance exhibits the property of simulating uniaxial properties at some temperature within its own life-range for every wave-length of light, while still retaining the general characters of monoclinic symmetry, including slight dispersion of the median lines. In this respect it resembles to a truly remarkable extent the analogous sulphate, which the author has shown to possess like peculiarities, but it is even more striking than the sulphate, as the dispersion is much larger. It is interesting to observe that these optical properties of cæsium magnesium selenate could have been predicted, given the constants of the potassium salt and the rules of progression established for the double sulphate and for the zinc group of double selenates. For the double selenates resemble the double sulphates so closely that in general it may be said that their properties are precisely parallel, the constants and curves being merely moved on to a slight extent by the replacement of sulphur by selenium without disturbing their relationships.

Physical Society, May 31.—Prof. S. P. Thompson, president, in the chair.—A paper on the resistance of dielectrics and the effect of an alternating electromotive force on the insulating properties of india-rubber, by A. W. Ashton, was read by Prof Fleming. The author has obtained from his experiments formulæ for the charging and discharging currents of a condenser with rubber dielectric. The currents are exponential functions of the time. Curves for various potential differences have been plotted and were exhibited. These curves show that the insulating properties of rubber are increased by the application of high alternating electromotive forces.—Prof. Fleming then read a note by Mr. Ashton on the electrification of dielectrics by mechanical means. A sheet of pure Para rubber was placed in a condenser, the plates of which were connected to a quadrant electrometer. A two-pound weight was then dropped upon the condenser from a height of 3 inches. The electrometer received two impulses of opposite sign, one quickly following the other. The rubber was then stretched while in position and a potential difference of seven volts was shown between the plates, the top plate being negative. The condenser and electrometer were then discharged, the sheet reversed and the experiment repeated. The same effect was produced, the top plate again being negative. It appears, therefore, that polarisation of a dielectric being thus produced by mechanical energy, some part of the mechanical energy expended on the india-rubber during manufacture would remain in the dielectric as electric energy.—A model which imitates the behaviour of dielectrics, by Prof. Fleming and Mr. Ashton, was exhibited by Prof. Fleming. The behaviour of dielectrics with regard to their residual charge is analogous to that of wires subjected to mechanical stress. A simple twisted wire is not, however, able to imitate all dielectric effects, and the present paper describes a model which represents things more completely. Six pistons, separated by springs, are placed inside a vertical cylinder. The bottom piston fits fairly tightly in the cylinder. The second piston fits slacker than the first. The third piston has a small hole in it, and each succeeding piston has a greater area cut away, the top piston having just sufficient metal left to make the spring come to rest without vibration after being compressed. The cylinder is filled with machine oil and vaseline. To the top piston is attached a rod by means of which pressures can be exerted on the pistons for any length of time. This represents the charging of the condenser. The motion of the rod after releasing the weights represents the discharge of the condenser. This is registered graphically by a revolving drum, and the curves obtained are very similar to those from condensers with dielectrics. Prof. Ayrton said he would like to know in what respect the model shown was superior to a strained wire. He had noticed, about ten years ago, that alternating E.M.F.'s appeared to improve condensers. He was then working with comparatively small voltages, and he was interested to know that Mr. Ashton, working with high voltages, had established the improvement. The deflection obtained by stretching the india-rubber sheet might be due to changes in temperature, the dielectric having a high