Society. The dielectric they used was carbon bisulphide (CS_2), and the beam of light passed through about four inches of the liquid. The presence and intensity of the electric field was evident to all by the brightness of the screen. They showed experiments to illustrate the fact that the repulsion of similarly electrified bodies may be regarded as an attraction between each of them and surrounding objects. They have devised an experiment visible to a large audience to show that in an electric field the structure of the CS_2 becomes crystalline—that is, the optical properties along and transverse to the electric lines of force are different; in other words, the velocities of propagation of light vibrations differ when parallel and perpendicular to the lines of force, contrary to the view formerly held on the Continent that the effect is due to unequal expansion. They were able to increase the stress so that the liquid displayed colours even to the green of the second order; and by observing the spectrum of the light passing through the field, black bands enter at the violet end and traverse its whole length as the potential rises. Faraday's experiments and speculations, Maxwell's mathematics and theories, are rapidly becoming acknowledged facts; and the apparatus of Messrs. Rücker and Boys will materially assist in spreading a knowledge of the confirmation which those theories receive from the work of Kerr and Quincke.

BLONDIOT (*Comptes rendus*, January 30, 1888) has been working in the same direction, but with vibratory discharges from a Leyden jar, in order to test the existence or non-existence of retardation in the optical effects. He could see no retardation.

COWLES's process for the production of aluminium from its ores by the direct action of an electric current of 5000 amperes in an electric furnace has now become an industry. Works have been started near Stoke, and bronzes of wonderful quality are supplied at comparatively cheap prices.

THERE is a fashion in experimental investigation as in everything else. Self-induction is played out, and now the counter E.M.F. of the arc is passing through the same phase. Uppenborn (*Beiblätter*, No. 1, 1882, p. 83) is the last inquirer. He finds for a current of 7.7 amperes and 10 mm. carbons, that $a = 35.4$ to 45.4 ; $b = 1.74$ to 3.2 in Edlund's formula—

$$E = a + bI.$$

Since a decreases both for an increase of current and for an increase in the section of arc, he leans to a resistance hypothesis rather than an E.M.F.

KLEMENCIE (*Beiblätter*, No. 1, 1888, p. 57) finds the specific inductive capacity of mica to be 6.64; Cohn and Arons (*Ann. der Physik*, No. 1, 1888, p. 13) that of distilled water 76, ethyl alcohol 26.5, amyl alcohol 15, and petroleum 2.04.

PALMIERI (March 1888) has observed that in a bright clear sky, with a high and steady barometer, and every indication of continued fine weather, the electro-meter will give an indication of change long before the barometer.

W. KOHLRAUSCH (*Electrotechnische Zeitschrift*, March 1888) has estimated the current and quantity of electricity in a lightning-flash. He calculates that it will take 9200 amperes to melt a copper rod of 2.5 centimetres diameter. Preece's constant (*Proc. R.S.*, March 1888) makes it 10244. Such a current concentrated in a flash would contain from 52 to 270 coulombs, which would decompose from 5 to 25 milligrammes of water, and from 9 to 47 cubic centimetres of explosive gas. If this energy were stored up and distributed for electric lighting, it would require from 7 to 35 such flashes to keep one glow lamp alight for an hour.

VOGEL (*Electrotechnische Zeitschrift*, January 1888) had previously calculated the relative value of copper and iron as lightning-protectors, giving iron a section 2.5 times that of copper to act with equal efficiency. Preece's constants give the relative efficiency—

Iron	3148
Copper	10244

for equal diameters—that is, an inch rod will fuse with the above currents in amperes; or, if we take the same current, say 300 amperes—

Iron	0.2086
Copper	0.095

are the diameters in inches of the wires such currents will fuse, or in the ratio 2.2 to 1; Vogel's ratio being 13.54 to 9.6.

Vogel did not consider the emissivity of the surface, and therefore his results are not so accurate as Preece's experimental figures.

THAT patient worker, H. Tomlinson, has proved that the temperature at which nickel begins to lose its magnetic properties is between 300° and 320° C.; but that the rate of decrease of magnetic permeability, and the temperature at which permeability practically vanishes, vary with the magnetizing force, and hence the widely different results by different observers. Faraday made the former point 330° to 340° ; Becquerel 400° ; Pouillet 350° ; Chrystal 400° . Iron behaves in the same way: permeability vanishes between 750° and 770° according to Ledeboer.

PROF. EWING AND MR. COWAN have been examining the magnetic qualities of nickel on the same lines as the former examined iron. They confirm Sir W. Thomson's observation that longitudinal pull diminishes magnetism to a surprising extent. Their paper in the *Philosophical Transactions* will be looked forward to with much interest.

S. ARRHENIUS (*Wiener Berichte*, xcvi. p. 831) has shown that the electrical conductivity of chloride and bromide of silver was influenced by the intensity of the rays of light which fell upon the salts. It was most intense at G of the spectrum, and is therefore an effect of light, and not of heat.

F. KOHLRAUSCH (*Wiedemann's Annalen*, No. 4, 1888) has shown that the electric conductivity of

Hard steel	is 3.3
Soft steel	„ 5.5
Wrought iron	„ 7.6

mercury being 1; while their thermal conductivities in C.G.S. units were—

Hard steel		0.062
Soft steel		0.111
Wrought iron		0.152

the ratios being the same. Hence the conditions that determine the conduction of heat and electricity are the same.

MR. C. V. BOYS's interesting magnetic and electric experiments with soap-bubbles, and his wonderful manipulative skill, remind old *habitués* of the Royal Institution how exquisitely Faraday handled soap-bubbles blown with oxygen to illustrate the magnetic character of that gas. Mr. Boys blows one bubble inside another, and, on bringing the two into an electric field, the perfect indifference of the inner one to any change of potential clearly shows that electrification is confined to the absolute surfaces of a conductor, and that it is not felt at any depth within it, however small.

WHEAT CULTIVATION.¹

THE most interesting sections of this number of the Journal are those bearing upon the subject of wheat cultivation. The permanent wheat and barley experiments at Woburn, reported upon by Sir John Lawes, Bart., is followed by a paper upon the condition of wheat-growing in India by Dr. George Watt, Reporter upon Economic Products to the Government of India. Next comes an article by Mr. W. E. Bear upon the Indian wheat trade. Lastly, in this connection, comes a highly interesting account of modern improvements in corn-milling machinery. These four papers occupy one-third part of the volume, and taken in connection with each other throw considerable light upon the difficulties under which the English wheat-grower is struggling. Dr. Watt and Mr. Bear both show the extraordinary extent of the wheat-producing area of our Indian Empire, and the rapidity with which this vast field is being opened up. With reference to the latter point men in middle life are scarcely likely to realize the fact that in 1853 there were in all only 20½ miles of railway in India, that in 1873 there were 5695 miles of railway, while in 1887 there were 13,386 miles. Telegraphic communication with India was first opened in 1865, and the opening of the Suez Canal in 1869 was scarcely of less importance in developing her trade—first, by shortening the passage, and secondly, by mitigating the risk from wheat weevil. Another agency has been the development of irrigation works.

¹ The Journal of the Royal Agricultural Society of England, vol. xxiv. (second series), part 1. (John Murray, Albemarle Street.)

We read that "only" 30,000,000 acres have up to date been artificially irrigated, but the appropriateness of the qualifying adverb is rendered evident when it is employed in contrast with the total area of 200,000,000 acres of cultivated ground, and the vast tract of 868,314 square miles which include British India. The normal area under wheat is 26,000,000 acres, and the degree to which this area is likely to be increased depends entirely upon demand and price. Dr. Watt informs us that the Indian cultivator is at all times ready to adapt his courses of cropping to circumstances, and that he will increase or abandon the cultivation of wheat, cotton, or any other crop according to its comparative profitability.

Dr. Watt comes to the conclusion that the Indian wheat trade up to the present time is a perfectly natural one. "The people are exporting only what they specially cultivate for that purpose. The moment better profits can be realized on another crop they will turn from wheat, without being in the least degree incommoded." If this is the case, the English farmer may well look with envy upon his Indian brother, as he is in the unfortunate position of being compelled to carry on wheat-growing from sheer inability to find a substitute for it in his agricultural economy. Natural though the course of the ryot may be from his point of view, the actual bounty upon wheat, or what amounts to a bounty, consequent upon the fall in value of the rupee, can scarcely be described as natural. This great advantage to the Indian cultivator is clearly brought out by Mr. Bear by the following considerations. First, the Indian ryot gets as much for a quarter of his wheat now as he obtained in 1872. He gets as many rupees, and his rupees are worth as much to him as they were then! In 1871-72 the average exchange value of the rupee was $1s. 11\frac{1}{2}d.$, whereas recently it has been under $1s. 5d.$ The price of No. 2 club wheat in Calcutta in 1872 averaged only $2rs. 3a. 1p.$ per maund, whereas it has for some time past been over $2rs. 10a.$ Taking $16rs.$ per quarter (6 maunds) as the price for both periods, then reckoning the exchange value of the rupee for both periods, it is clear that the exchange value of $16rs.$ in 1872 was equal to $30s. 8d.$ per quarter, whereas the exchange value of the same sum in 1888 is only $22s. 8d.$ The fact is that the Indian ryot gets as much for a quarter of wheat now as he did in 1872, in spite of the fall in prices. He gets as many rupees, and his rupees are worth as much to him. This seems to settle the question as to the encouragement given to the ryot as a competitor in wheat-growing with the English farmer. Another point, in all respects discouraging to the cultivation of wheat in England, is found in the complete revolution during the last ten years in corn-milling machinery described by Mr. W. Proctor Baker, of Bristol. There has been in fact not a mere substitution of one machine for another, or of one series of machines for another, but there has been a change of the principle and mode of procedure. The old system of "low grinding" by mill-stones, so well calculated for producing flour from soft, tender wheats, such as are produced by us, has been entirely superseded by the Hungarian and American "gradual reduction" process by "roller mills." Not only does this system require the wheat to be dry, hard, and brittle, so as to secure the requisite cracking and gradual reduction, but anything in the form of a soft or moist wheat is most injurious to the machinery and the products. It rolls into a paste, steam is generated, and the flour works into balls, becomes attached to the rollers, turns sour, and, in fact, throws the entire process out of gear. "It is because of these troubles that owners of mills on a large scale will not employ native wheats in damp seasons. No concession of price is sufficient inducement to them to risk the disorganization of the mill, and probable loss of reputation, by turning out inferior or irregular flour." There are, however, two modes in which these wheats may be used. First, by submitting them to an artificial drying process; and secondly, by mixing them with some description of very brittle wheat, and allowing the mixture to lie for some weeks, until the brittle wheat absorbs some of the moisture of the native wheat, to the mutual advantage of both.

One of the most serious points at issue between science and agricultural practice at present appears to be the comparative values of farm-yard manure and artificial fertilizers. So far as absolute experiment goes, the evidence seems to be in favour of the application of the latter, while, on the other hand, the preponderating opinion among farmers is on the side of farm-yard manure. In the Report on the Field and Feeding Experiments at Woburn, by Dr. J. Augustus Voelcker, applications of dung appear somewhat at a disadvantage when contrasted with applications of salts

of potash, phosphates, and nitrates direct. Mr. Vallentine, in his paper upon the practical value of dung as compared with artificial manures, declares in favour of the latter, and labours to show the extravagant cost at which farm-yard manure is produced. "For years past," he says, "my main reliance has been placed on artificial manures. Some dung is made and some bought, but it is found to answer best, as a rule, to sell hay and straw and to purchase manures." This may answer on some classes of soil; but what would be the effect upon our high-lying and thin chalk downs if we were to relinquish sheep-farming and depend upon "artificial?"

Many more valuable papers well repay perusal, among others one upon recent experiences in laying land down to grass, by Mr. James A. Caird. The remainder are mostly official in character, being the usual Reports upon implements, prize farm competitions, shows, experiments, and the Annual Reports of the Consulting Chemist, Botanist, and Entomologist, which, however, are none the less valuable for being official.

Downton.

JOHN WRIGHTSON.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following are the speeches delivered on June 9 by the Public Orator, Dr. Sandys, Fellow and Tutor of St. John's College, in presenting for the honorary degree of Doctor in Science, Prof. G. G. Stokes, Lord Rayleigh, Sir Frederick Abel, Prof. Cayley, and Prof. Adams:—

(1) *Salutamus deinceps Regiæ societatis præsidentem, professorem nostrum Lucasianum, senatorum nostrorum omnium consensu Britannici senatoribus additum; quem in munere illo triplici Newtoni nostri in vestigiis insistere gloriamur. Atqui ipse, qua est morum suavitate et modestia, vix tali sese honore dignatur, sed a plausu populari remotus et seclusus, templum quoddam serenum occupat, ubi reverentia debita rerum naturæ miracula perscrutatur, ubi "in statione tranquilla collocatus" lucis leges obscuras observat, observatas ingenti sui lumine illustrat. Viro tali rerum naturam contemplanti crediderim apparere nonnunquam sedes illas quietas,*

"quas neque concutiant venti, nec nubila nimbi aspergunt, neque nix acri concreta pruina cana cadens violat, semperque innubilis æther integrit, et large diffuso lumine ridet."

Duco ad vos virum illustrem, PROFESSOREM STOKES.

(2) *Venio ad nomen physicorum professoris quem non sine desiderio nuper amissimus, viri cum Cancellarii nostri munificentia haud ita pridem consociati. Ex illo velut fonte, liberalitatis flumen amplum professoris nostri in provinciam defluxit inque alias Academiae partes redundavit. Ipse fontium exsiliuntium et aquarum destillantium naturam quam feliciter exploravit; caeli colorem illum caeruleum quam dilucide explicuit; quicquid audiendi quicquid videndi ad rationes intimas pertinet, quam sapienter interpretatus est; quotiens in rerum natura eventis specie quidem inter sese diversis causas easdem subesse ostendit. Quam profundam rei mathematicae thesaurum, ut aiunt, cum quanta in experimentis instituendis sollertia coniunxit; quam subtile denique scientiae cognitionem cum sensu illo communi consociavit qui non in magna tantum fortuna sed in omni vitae condicione rerum omnium est revera rarissimus.*

Duco ad vos IOANNEM WILELMUM STRUTT, BARONEM RAYLEIGH.

(3) *Scientiam Chemicam et in bello et in pace utilem esse, quis negabit? Heri in hoc ipso loco virum hunc insignem docentem audivistis, quo potissimum modo scientia illa populi salutem consulere et pericula pacis in artibus suscepta possit avertere. Idem Martis fulmina illa antiquis ignota quam familiariter tractat: pulverem illum formidolosum quo Bellona gaudet, quot experimentis vexat: quam admirabilem in modum velut Olympius ille Aristophanis, fulgurat, tonat, omnia permiscet. Atqui non minus quam Pericles ille Atheniensis, qui tot insularum imperium civitati suae conciliavit, inter ipsa tonitrua audit tot coloniarum Britannicarum uno in imperio coniunctarum vocem, et illorum consiliis pro virili parte optulatur qui in ipsa μητρόπολει artium et scientiarum templum quoddam tanto imperio dignum consecrare voluerunt. Templi illius e sacerdotibus unum, cuius praeceptor coram Principe nostro in hoc senaculo quondam*