

it was shown that for fair comparison the coarser and the finest particles should be separated by sieving and washing, so as to obtain clean grains having on an average a diameter of about  $\frac{1}{100}$ th of an inch. On examining such sand from different deposits and different localities, it is seen that the amount of wearing varies very greatly. Much remains to be learned respecting the detail, but the observations made hitherto show that certain deposits are as if derived almost directly from crystalline rocks, that a very considerable amount of mechanical action is required to round angular grains of quartz  $\frac{1}{100}$ th of an inch in diameter, and that in proceeding from the apparent source in crystalline rocks the amount of wearing increases, until, when the sand has been drifted for 100 or 200 miles, about one-half of the grains are well worn and rounded. The uniformity in character over wide districts is sometimes remarkable and very characteristic.

Certain special questions connected with the structure of fine-grained deposits were then considered, amongst which may be specially mentioned the lamination of shales. It was shown that after complete subsidence such fine-grained muds contain so much included water that if squeezed out by the vertical pressure of superincumbent strata, the bulk would be reduced to at least  $\frac{3}{4}$ th, which would necessarily develop a fissile structure in the plane of stratification, analogous to, but much less perfect than, the transverse cleavage of slates due to lateral pressure.

The nature of the more characteristic materials of fine-grained slates was next considered, and it was shown that they must originally have often differed very greatly from the more modern deposits of granular mud to a great extent derived from the decomposition of granitic rocks, this difference being mainly due to their having been derived to a large extent from the decomposition of the fine-grained basis of certain felsitic ashes. On the contrary, the characteristic features of the green slates of the English Lake District are mainly due to the material having been derived from a mere doleritic type of ash. One of the most striking facts is the great amount of true pumice, the originally empty cells of which are now filled with calcite or with various green minerals, in the same manner that the cells of foraminifera are often found filled with glauconite.

The author then pointed out how some difficulties connected with the mechanical origin of slaty cleavage could be easily removed, and traced the gradual passage from an ordinary stratified, non-cleaved slate to one with an imperfect cleavage due to the development of close joints or planes of discontinuity, and finally to a perfect cleavage, when the yielding of the mass to lateral pressure was sufficiently great.

The next questions which claimed attention were connected with the chemical changes that have occurred in the rocks since they were deposited. These have often given rise to a well-marked group of minerals, of several different kinds, but usually of green colour, and their development has played an important part in strata of nearly every age, resulting in the formation not only of the green grains of the green sand, but also in the analogous green constituents of many slates.

The author then discussed very carefully the gradual development of mica-schist, tracing it from what might be called its very germs, in grains only  $\frac{1}{100}$ th of an inch in diameter, formed *in situ* in some slates, to cases in which the whole of the original constituents of the slate have re-crystallised *in situ* into mica and quartz. In rocks of this type we can clearly see that the foliation is not due to deposition, but to crystallisation, which has been greatly influenced, not only by the previously existing structures due to stratification, but also by those due to cleavage previously developed by lateral pressure. Such fine-grained connecting links between slates and schists differ from true schists only in being of finer grain, which is sometimes so fine that with the naked eye it would be almost impossible to distinguish between them and slates, though the microscope shows that true slates have been deposited as mud, whilst the fine-grained schists have re-crystallised *in situ*.

The author concluded by specially considering what evidence remained in the most typical schistose rocks of the former presence of the grains of sand and of the fine granular particles found in slates, and showed that although they could sometimes be detected, yet in many cases the whole rock is so completely crystalline, that all evidence had been obliterated. The proof of crystallisation *in situ* is, however, very complete, so that, though we can see clearly that the original rock must have been greatly changed, we cannot really prove from its structure what the rock originally was—whether it was detrital or a mass of

small crystals. This re-crystallisation of the material *in situ* is more especially proved by the structure of those schists which possess *cleavage foliation*. This differs most characteristically from *stratification foliation*, and clearly proves that before crystallisation took place the structure of the rock had been altered by lateral pressure.

It will thus be seen that the main object of the address was to trace the origin of the constituents of modern or more ancient sand and mud from pre-existing crystalline rocks of different types, and to show the correlation of the most modern and the most ancient deposits, and finally to trace the changes that have occurred since deposition, until they reach their extreme in the reproduction of crystalline rocks, thus completing the entire cycle of chemical and mechanical changes.

#### UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE petitions of Owens College and Yorkshire College relative to the creation of the "Victoria" University, have been printed as a parliamentary paper, with the draft of the proposed charter, the main heads of which we have already given. We believe this draft now only awaits the sanction of Parliament to become law.

DR. WILLIAM RAMSAY, of the chemical laboratory of the University of Glasgow, has been appointed to the Chair of Chemistry in University College, Bristol, in room of Dr. Letts, who has succeeded Dr. Andrews in Queen's College, Belfast.

MR. T. J. PARKER, B.Sc. (Lond.), son of Prof. W. K. Parker, F.R.S., has been selected for the Professorship of Biology in the University of Otago, New Zealand, and Curatorship of the Otago Museum. Mr. Parker has for some years been Demonstrator of Biology in the laboratory of the Royal School of Mines, South Kensington. We understand that three Commissioners were appointed by the University Council to report on the qualifications of candidates. The candidates, we believe, were numerous and highly qualified.

PROF. LÖWIG, who occupies the chair of chemistry at the University of Breslau, celebrates on April 7 the fiftieth year of his doctorate. As his laboratory courses have always been largely attended by pharmaceutical chemists, of whom over 1,000 have pursued their studies under his guidance, a movement has been set on foot to endow in honour of the occasion a pharmaceutical scholarship, to bear the name of the veteran professor. Although the University of Breslau occupies by no means the first rank among German universities, still the salary and fees falling to the share of the occupant of the chair of chemistry, form a sum far in excess of that received by any other professor of chemistry in the empire. Second on the list in this regard is the professorship of chemistry at Würzburg, now held by Prof. Wislicenus. In both cases the fact is mainly due to the large affluence of medical students who are forced to take courses of chemical lectures.

THE authorities of the Zurich Polytechnic are making preparations to celebrate next August the twenty-fifth anniversary of the foundation of the institution. In view of the widespread influence which the Polytechnic has exerted on the recent development not only of the canton but of the entire republic the occasion will be one of no slight interest.

THE *New Freie Presse* makes the following comparison of schools and school attendance in different European countries:—Germany, with a population of 42,000,000, has 60,000 schools and an attendance of 6,000,000 pupils; Great Britain and Ireland, with a population of 34,000,000, has 58,000 schools and 3,000,000 pupils; Austria-Hungary, with a population of 37,000,000, has 30,000 schools and 3,000,000 pupils; France, with a population of 37,000,000, has 71,000 schools and 4,700,000 pupils; Spain, with a population of 17,000,000, has 20,000 schools and 1,600,000 pupils; Italy, with a population of 28,000,000, has 47,000 schools and 1,900,000 pupils; and Russia, with a population of 74,000,000, has 32,000 schools and 1,100,000 pupils.

#### SCIENTIFIC SERIALS

THE *Journal of the Royal Microscopical Society*, containing its transactions and proceedings and a record of current researches relating to invertebrata, cryptogamia, and microscopy, Feb

ruary, 1880.—Rev. W. H. Dallinger, on a series of experiments made to determine the thermal death-point of known monad germs when the heat is endured in a fluid (Pl. 1 and 2).—Dr. P. M. Duncan, on a part of the life-cycle of *Clathrocystis arginosa* (Kützing).—Prof. E. Abbe, some remarks on the apertometer.—A. D. Michaël, a further contribution to the knowledge of British Oribatidæ, part 1 (Pl. 3 and 4). With the assistance of C. F. George the life histories of fifteen species are mentioned as traced for the first time, the same number are described as new to the British fauna, and of these four are new species, five have been previously found in France, four in Germany, one in both of these countries, and one in Spitzbergen. Part 2, with two more plates, is promised in the April number.—G. Gulliver, the classificatory significance of raphides in Hydrangea.—W. Teasdale, on a simple revolving object-holder.—The record of current researches, bibliography, and proceedings of the Society.

*Zeitschrift für wissenschaftliche Zoologie*, Bd. 33, Heft 4, January 23.—Dr. Philipp Stöhr, on the history of the development of the skull in the Urodela, pl. 29, 30.—Karl Richard Krieger, on the minute structure of the central nervous system in the crayfish, pl. 31, 33.—Dr. Julius Krueg, on the fissures of the cortical surface of the cerebral hemispheres of the zonoplacental mammals, pl. 34, 38.—J. Ciamician, on *Lafœia parasitica*, sp. n., pl. 39, figured on a species of *Aglaophenia* from Trieste.

*Reale Istituto Lombardo di Scienze e Lettere, Rendiconti*, vol. xiii., fasc. ii.—On the *trichamœba irta* of De Fromontel and Me. Jobard-Muteau, by Prof. Maggi.—On the transmission of heat between two fluids in motion separated by a solid wall, by Dr. Grassi.—On some geometrical and mechanical relations concerning lines of double curvature, by Prof. Bardelli.

*Journal of the Franklin Institute*, January.—Locomotive spark-arresters, by Mr. J. S. Bell.—Standard sizes in cylindrical fitting, by Mr. Richards.—Saws, by Dr. Grimshaw.—On the method of milk shipment in glass jars, by Dr. Morris.—Velocity of light, by Dr. Chase.

*Gazzetta Chimica Italiana*, fasc. i.—Crystallographic study of some substances of the aromatic series, by Signor La Valle.—Further observations on digallic acid, by S. Schiff.—Contribution to the chemical history of the Stereocaulon Vesuvianum, by S. Coppola.—New method of determining the points of fusion of organic substances, by S. Roster.—Researches on podophyllin, by S. Guareschi.—Chemical study of the meteorite of Albarello, by S. Maissen.—Chemical researches on the yellow incrustations of the Vesuvian lava of 1631, by S. Scacchi.

## SOCIETIES AND ACADEMIES

### LONDON

Royal Society, February 26.—“On some of the Effects produced by an Induction Coil with a De Meritens Magneto-Electric Machine.” By William Spottiswoode, P.R.S.

In the *Philosophical Magazine* for November of last year I gave an account of a mode of exciting an induction coil by the direct application of one of M. de Meritens's alternating machines, without the intervention of a contact-breaker or the use of a condenser. The experiments of Prof. Dewar, described before the Royal Society (see *Proceedings*, February 13, 1880), have led me to think that an account of some of the peculiarities in the induced discharge, might be acceptable to the Society.

And, first, as regards the secondary discharge in air. It was mentioned in the paper first quoted that the spark produced by this machine presented an unusually thick yellow flame, and that it was accompanied by a hissing noise different from that commonly heard with a coil excited by a battery. The spark was observed in a revolving mirror, first in a vertical and secondly in a horizontal direction. The discharge, although apparently continuous, was immediately seen to be intermittent, with a period in unison with that of the machine. Tongues of flame, leading alternately from one terminal and from the other, crossed the field of view. The length of spark first used (vertically) was about half an inch. When the length was increased to about two inches flashes or bands of continuous light were seen to traverse the field of view in diagonals of low slope (*i.e.*, nearly horizontally), showing that there were masses of heated matter passing from time to time at moderate velocity between the terminals. From the known period of the machine and the

number of the discharges crossed by these flashes in their passage from terminal to terminal, it was calculated that the time of passage was about  $\cdot 03$  of a second. Occasionally there was a still brighter flash or meteor, which similarly traversed the field, but with a velocity apparently of about double that of the others.

On observing the discharge (vertical) in air attentively, it was noticed that whenever a true spark passed, its passage was marked, as usual, by an irregular bright line when its path was outside the aureola or flame, but by a similar dark line when its path was within the aureola.

The spectrum of the secondary spark was then examined with terminals of various metals.

*Aluminium*.—The spectrum showed a faint continuous background with the yellow sodium lines, and faint oxide of aluminium lines. This was with a spark of half an inch. But although the spark was subsequently lengthened, no difference in the spectrum was perceived excepting that the continuous background was rendered more bright.

It would seem that these appearances are due to some such process as the following:—The heat due to oxidation, added to that of the discharge, is sufficient to volatilise the oxide of aluminium, but that in its passage across the interval between the terminals, the oxide becomes so cooled that it gives a continuous spectrum. When the spark was lengthened, the oxide, although perhaps at first more heated than with the shorter spark, had more time to cool.

*Magnesium*.—In this, as in the former case, we have a faint continuous spectrum as a background, on which were seen the *b* group of magnesium lines. One other line in the blue occasionally flashed out, but was not permanently present. There was also a faint trace of the oxide spectrum. The contrast between the cases of aluminium and magnesium, in respect of the prominence of the oxide, or of the true metallic spectrum, is doubtless due to the fact that in the former case the oxide, and in the latter the metal, is the one which is more easily vaporised. On sending a blast of air on the discharge, the blue line always disappeared; the current of air having lowered the temperature so far as to prevent the vaporisation necessary for its production.

When the spark between magnesium terminals was made to pass through hydrogen, the characteristic lines of hydrogen were seen, apparently owing to a rise in temperature. This, as mentioned below, does not occur with carbon poles.

*Platinum*.—With terminals of this metal the spectrum was mainly continuous, with the addition of the ubiquitous yellow sodium lines. When the spark was short, a few bands were faintly visible, some apparently those of nitrogen, and others in the blue and violet belonging to the oxide of platinum. When the spark was lengthened these bands disappeared, and nothing but the continuous spectrum (with the D lines) was visible.

It appears from these experiments that the application of the De Meritens machine to the induction coil furnishes us with the means of isolating certain lines of the metallic spectrum from the rest. It has, in fact, enabled us to reduce at pleasure the spectra of aluminium, of magnesium, and of platinum, to their most persistent lines, precisely as had already been noticed as occurring by natural processes in the cases of sodium and of calcium. As a general rule, when the spark is shortened, the metallic or the oxide lines come out, when it is lengthened they disappear.

From this we may conclude (1) that the discharge which we have been examining is a real flame with metallic particles passing between the terminals in a solid condition; and (2) that in general the temperature is comparatively low, *i.e.*, that it is insufficient to cause any considerable vaporisation. This is notably the case when the arc is long, and when the matter thrown off from the terminals has sufficient time in its passage to cool.

The spark was then tried between carbon terminals in atmospheres of hydrogen and of carbonic acid. In none of them did the spectrum show any gas lines, but with hydrogen there were faint traces of the hydrocarbon group in the green. In this respect the spark differs from the discharge direct from the machine, inasmuch as the latter gives some of the hydrogen lines in hydrogen and carbon lines in carbonic acid.

When magnesium terminals were used in an atmosphere of hydrogen, the yellow sodium lines, the blue and green magnesium lines, and the red line of hydrogen were visible near the terminals, with a continuous background. When the magnet was excited, the only change observed was that the lines became slightly fainter.