

Research Items.

Roman Pottery Kilns in Yorkshire.—The investigation of a Roman pottery kiln site at Throlam Farm, near Holme-on-Spalding, is recorded in the *Transactions of the East Yorkshire Antiquarian Society*, vol. 27, pt. 1, by Mr. T. Sheppard and Mr. P. Corder. The site is a mound, about a hundred feet in circumference and about six feet above ground level, consisting almost entirely of wood-ash and sherds. Near the centre is a mass of puddled clay forming a mound 14 ft. by 7 ft., stratified into clearly marked layers by bands of black ash and sherds, representing successive occupations or reconstructions. On the west end of this are two roughly constructed kilns, 3 ft. 6 in. and 2 ft. 7 in. in diameter respectively, which were fed from the same stokehole. They were constructed on the oven floor of an earlier and larger kiln which was itself superimposed on another. This larger kiln has been almost completely preserved. It differs from the usual type of small Roman pottery kiln only in certain particulars. No pit was excavated, but a mass of puddled clay was dumped on the floor of the kiln, and from this the later kiln was fashioned. The floor was supported on pillars which divided the furnace into three. The pottery, with the single exception of a Samian sherd, is of the Yorkshire coast Signal Station type of the last part of the fourth century; but as the bulk of the pottery is earlier than that of Huntcliffe or Scarborough, the most probable date is the later half of the third century.

Blood Standards for Indians.—In the course of study of anæmia in the Bombay Presidency, it was realised that no normal standards for Indians are available with which pathological findings can be compared. Even accepted European standards are found to present considerable variations in different text-books. Major Sokhey and his assistants have therefore examined 121 healthy young Indian men and 101 women living in Bombay by approved methods and with specially standardised apparatus (Report of the Haffkine Institute for the year 1929, p. 26; Bombay, 1931). The following averages have been obtained:

	Men.	Women.
Red cell counts, millions per cubic mm.	5.11	4.47
Hæmoglobin—grams per 100 c.c. of blood	15.36	12.99
Volume of cells, c.c. per 100 c.c. of blood	41.72	36.27

Isolation of Sexes in Bird Movements.—In a short paper in the *Naturalist* (May 1931, p. 145), Noble Rollin is able to confirm the statement that as a rule female birds form the vanguard in migration, and that the males show a tendency to lag behind. The result is the more interesting because it has been found amongst birds in which the sexes cannot be determined by examination in the field. Birds were collected at random in the neighbourhood of South Shields, and grouped themselves in a series of six common land birds and seven waders and sea birds, a mixed bag of migrants and partial migrants. The sex was determined by dissection. On the whole, the results revealed by the two sets of records are very consistent. It would appear that during late autumn (October and November) the stock of birds is predominantly female, whereas in the winter (December and January) it is predominantly male. The curve in which the results are expressed illustrates the instability of the bird population of an area during autumn and winter, and this is apparently due to sexual dimorphism in the migratory movement.

Golgi Bodies and Yolk.—Allahabad University Studies, vol. 6, pt. 2 (Science Section), 1930, contains contributions from the Departments of Zoology, Chemistry, Botany, and Mathematics. Five of the seven zoological papers are on the cytology of oogenesis respectively of tortoises, the gecko, *Pila* (apple snail), frogs and toads, and fishes. In the tortoise, "fatty yolk is formed directly and indirectly by Golgi bodies", while albuminous yolk is formed either "by direct metamorphosis of mitochondria into a yolk body" or by other activity of the mitochondria; nucleolar extrusions take no part in the formation of yolk. In the gecko, the Golgi bodies "appear to play no part whatever in vitellogenesis". In *Pila*, the Golgi bodies contribute directly or indirectly to the formation of fatty yolk spheres; later the mitochondria multiply rapidly, swell, and give rise to true yolk spheres by a process of direct metamorphosis. In the frogs and toads, the Golgi bodies appear to take part in the formation of fatty yolk, though whether by direct metamorphosis was not determined. The true yolk is formed by the metamorphosis of mitochondria. In the fifth paper is described the infiltration of Golgi bodies, either in "big lumps or, as is more frequent, in the form of granular bodies", from the follicular epithelium through the zona radiata into the oocyte of the fishes *Saccobranthus fossilis* and *Ophicephalus punctatus*.

Hard Fibre Production within the Empire.—An interesting lecture upon this subject by Mr. Alfred Wigglesworth is reproduced in the *Journal of the Royal Society of Arts*, vol. 79, No. 4087, Mar. 20, with an abstract of the interesting discussion that followed the lecture. The hard fibres referred to occur in the leaves of monocotyledons, and for many purposes they are now being exploited, at the expense of the fibre from the inner fibrous bark of dicotyledonous plants such as flax and hemp. They include New Zealand flax, *Phormium tenax*, *Furcraea gigantea* (mainly exported from Mauritius), and *Agave cantala*. In every case, the successful introduction of such a hard fibre depends upon the development of methods for the separation of the comparatively small amount of fibre from the tough leafy tissues; and the rapid development in recent years of the hard fibre trade is very largely due to the success with which the problem of the large scale extraction of sisal fibre has been attacked. Sisal has long been cultivated in Mexico, but in 1836 Mr. Perrine transported suckers to Florida. From the Florida plants, by vegetative propagation practically the whole area now under sisal outside Mexico, in East Africa, Dutch East Indies, etc., has been supplied. Mr. Wigglesworth points out that there is ample room for scientific study of the breeding, cultivation, and methods of extraction, purification, and grading of all these fibres. One point of great interest is that the sisal fibre has a larger cell lumen than the Manila fibre (from *Musa textilis*) and Mr. Wigglesworth thinks that this explains why sisal absorbs more water—and more rapidly—than Manila fibre. The *Bulletin of the Imperial Institute*, vol. 29, No. 1, 1931, contains a report of the effect of sea-water on the strength and durability of sisal hemp in comparison with Manila. Three series of trials have been completed and the results afford clear evidence that East African sisal has satisfactory durability in sea-water.

The Wilberforce Radium Occurrence.—Under this title, H. S. Spence and R. K. Carnochan have recently described the richest deposit of radium ore yet found

in Canada (Dept. of Mines, Canada : *Investigations of Mineral Resources and the Mining Industry, 1929*, Ottawa, 1930, pp. 1-23). The ore consists of uraninite disseminated in large crystalline and aggregates through strings and long miarolitic pockets of calcite and fluorite, with subsidiary apatite, occurring in a syenite-pegmatite, which itself contains large pockets lined with felspar crystals. The uraninite-bearing 'lead' is considered to be at least 500 ft. long by 5-12 ft. wide. Tests on a carload of ore showed that 1 gm. of radium would be recoverable from the concentrates separated from 3422 tons of ore. This result, and the development work carried out in the field, suggests that the occurrence has commercial possibilities. An analysis by Ellsworth of the uraninite shows U_3O_8 , 61.64 per cent; ThO_2 , 13.56 per cent; and PbO , 11.05 per cent, corresponding to an age of more than 1200 million years. It is of interest to record that, according to reports recently published in Montreal, pitchblende deposits have been found at Echo Bay on Great Bear Lake, 750 miles by river navigation from the railroad at Waterways, Alberta.

A Survey of Niagara Falls.—A phototopographical survey of Niagara Falls was carried out in 1927 by the Geological Survey of Canada, and is fully described by Mr. W. H. Boyd in *Memoir 164* of the Geological Survey. Work on the American Fall was comparatively easy since, owing to the small volume of water, the rock crest is visible from end to end. In the Horseshoe Fall, however, the central part is completely covered and offers no points of identification. To overcome this difficulty, three cameras, one at each of three stations, were exposed simultaneously. Thus the appearance of the water along the width of the crest was revealed at the same instant from each of three stations. It was found to be easy to identify the same points of the water face in all the three photographs. Thus the crest could be mapped. Elevations along the crest line were also taken. Details of the methods employed are given in a pamphlet accompanying the surveys.

The Queen Maud Range, Antarctica.—This huge faulted range of mountains at the south-eastern end of the Ross Sea was discovered by R. Amundsen in his march to the South Pole in 1911. He charted roughly only a limited area on a small scale, for his field of vision was naturally limited. Amundsen's map appeared in his book "The South Pole" (1912). Admiral R. E. Byrd crossed the range to the west of Amundsen's route in his flight to the South Pole in 1929. From his height, the range of vision was considerable. The survey material from his aerial photographs was amplified by Prof. L. M. Gould's sledge journey along the base of the range. From all the available data, the American Geographical Society has produced a contoured map of the Queen Maud Mountains on a scale of 1 : 500,000, which is about ten times the scale of Amundsen's map (*Geographical Review*, April 1931). Positions are fixed from three astronomically determined points at which wireless time signals were observed. The map reveals three immense glaciers, named Amundsen, Thorne, and Leverett, comparable in nature with the Axel, Heiberg, and Liv glaciers of Amundsen and the Beardmore glacier of Shackleton. It gives the trend of the Queen Maud Range a more easterly direction than Amundsen had observed and disposes of his Carmen Land. The map is a valuable contribution to Antarctic cartography.

An Exceptional Night Sky.—Lord Rayleigh, in the May number of the *Proceedings* of the Royal Society, describes an unusual night sky which was watched

by him at Terling (52° N.) on Nov. 8, 1929. The light was much the same in constitution as on ordinary nights, extending uniformly over the sky, but was very much brighter than usual, and of constant intensity over a period of hours. Its spectrum seemed continuous, and the green auroral line ($\lambda 5577$) was not definitely seen. It was evidently of a totally different nature from the polar auroral light, and, confirming this distinction, the state of the earth's magnetism was steady. The negative bands of nitrogen could not be searched for on this occasion, as they were outside the range of the spectroscope used, but Lord Rayleigh says that in his experience the most striking distinction between the ordinary night sky and the polar aurora is the absence of the bands from the former; a contrary conclusion has, however, been arrived at by Sommer, who finds that these bands are present in the normal night light at Göttingen. Lord Rayleigh has remeasured the two unidentified lines (or band heads) in the night sky spectrum at $\lambda 4419$ and $\lambda 4168$.

Recombination of Cæsium Ions.—The information afforded by quantitative study of recombination of electrons and ions is of very great value in testing theories of many atomic processes, giving essentially the effective cross-section of an atom or ion under various conditions. An account of an investigation of the recombination of cæsium ions and electrons to form normal (1^2S) atoms of cæsium, given by C. Boeckner in the February number of the Bureau of Standards *Journal of Research*, is of particular importance because it verifies the fact that the normal state of cæsium is anomalous in its behaviour; recombination into two of the excited states of cæsium (2^2P and 3^2D) takes place in the simple way which would be expected from the quantum theory of the hydrogen atom, whereas recombination into the more tightly bound 1^2S state follows an entirely different law. The results were obtained by Mohler's method of measuring the intensity of the continuous recombination spectra which appear at the series limits, simultaneously with a probe wire analysis of electron velocities by Langmuir's method, and furnish incidentally a proof of the correctness of the current theory of exploring electrodes.

Electrical Resistance of Moisture Films on Glazed Surfaces.—In measuring the electrical resistance between two conductors separated by a mass of insulating material, it has long been known that the apparent value of the resistance depends on the humidity of the air and the previous history of the insulator. It is usual to divide the current which flows between the two conductors into two components, one flowing through the insulator and the other through a film of moisture or other conducting material on the surface of the insulator. In actual tests, the relative values of these two currents vary largely, since water, even when very pure, conducts much better than ordinary insulators; the surface leakage current may be many times greater than the component which flows through the solid insulator. In a paper published in the March number of the *Journal of the Institution of Electrical Engineers*, G. G. Smal, R. J. Brooksbank, and Prof. W. M. Thornton discuss how the electrical resistance of moisture films on glazed surfaces varies with the resistance, temperature, and vapour pressure of the surrounding medium. Their experiments show that there is a very sharply defined critical pressure above which the resistivity falls as the pressure rises, and below which they both fall together. The drop of voltage down a string of insulators depends on the

surface resistance as well as the capacitance of the units. When a steam jet is played on the string until there is a complete deposit of visible moisture, the voltage gradient becomes a straight line. The potential to earth of the lower units is sometimes more than doubled. Stabilising devices, therefore, at the earthed end of the string of insulators may be more effective in preventing flashover on the string. The experiments show that water films are deposited or adsorbed on glazed surfaces long before they are visible as dew.

Ohm's Law for Electrolytes.—Experiments made in 1927 by Wien on electrolytic conduction in fields of 30,000–300,000 volts per cm. indicated an increase of conductivity with field strength, amounting to as much as 50 per cent. These results have been interpreted in the light of the modern theory of strong electrolytes, by assuming that in the case of high ionic velocities there is no opportunity, or only a restricted opportunity, for the ion atmosphere of opposite sign to build up around the moving ion, so that the retarding effect of this atmosphere, giving rise to a change of equivalent conductivity with dilution, is not fully exerted. More recently, Wien has found the effect for field strengths so low as 3000 volts per cm. These experiments show that Ohm's law is not valid for electrolytes over the entire range of voltages. Although it would not be expected in the case of the low field strengths used in the Kohlrausch method of determining conductivities, a change of resistance with applied voltage has been reported by Parker. In the April number of the *Journal of the American Chemical Society*, Jones and Bollinger show that with low field strengths the voltage used is without effect on the measured resistance over a wide range of frequencies and of resistances, and with cells of widely varying design. Ohm's law may, therefore, be regarded as valid for electrolytes under these conditions.

The Nature of the Chemical Bond.—Recent applications of quantum mechanics have led to an approximate calculation of the energy of formation and other properties of very simple molecules, such as H_2 , and have provided a formal justification for the rules stated by G. N. Lewis in 1916 for the electron-pair bond. Linus Pauling, in the April number of the *Journal of the American Chemical Society*, extends these applications and supplements Lewis's rules for the electron-pair bond by new rules which provide information regarding the relative strengths of bonds formed by different atoms, angles between bonds, free rotation or lack of rotation about bond axes, etc. A detailed theory of the magnetic moments of molecules and complex ions is also developed, the value of μ being given by $2\sqrt{S(S+1)}$, where S is the total spin angular momentum, the moment being determined entirely by the number of unpaired electrons. This relation, which does not apply to rare-earth ions, makes it possible to decide from magnetic observations between electron-pair bonds and ionic and ion-dipole bonds for various complexes. The tetrahedral carbon, nitrogen, and phosphorus atoms in appropriate compounds are reproduced, and the known results for rotation about single bonds (except when restricted by steric effects) and lack of rotation about double bonds follow. Several examples of the determination of structure from a knowledge of the calculated angles between bonds are given. On the theoretical side, special attention is directed to the effect of concentration of the bond eigenfunctions. The type of bond formed by an atom is dependent on the ratio of bond energy to energy of penetration of the core. When this ratio is small, the bond eigen-

functions are p eigenfunctions giving bonds at right angles to one another, but when it is large, new eigenfunctions especially adapted to bond formation can be constructed.

Metallic Corrosion.—Two papers communicated by Sir Harold Carpenter to the Royal Society, and published in the May number of the *Proceedings*, furnish a great deal of information about the mechanism of corrosion of metals. The first, by U. R. Evans, L. C. Bannister, and S. C. Britton, is on the velocity of corrosion from the electrochemical point of view. Currents flow between anodic and cathodic parts of corroding metals, and it has been shown that the currents measured are equivalent to the corrosion produced, the problem of corrosion speed being thus largely reduced to a study of the electrochemical factors which determine this current. One of the important factors which enters is polarisation set up by the current; it occurs in most cases at the cathodic area, and is due to limitations in the rate of supply of oxygen. When corrosion starts at a weak point in an invisible film covering the surface of a metal, the area being attacked changes until the current density over it is equal to a certain 'protective value', which is the current density which will cause any incipient attack on a weak point within the area in question to lead to a precipitation of rust so close to the surface as to seal the defect, a principle made use of in the 'cathodic' method of preventing corrosion. The second paper, by G. D. Bengough, A. R. Lee, and F. Wormell—the fourth of a series on the theory of metallic corrosion—is chiefly upon the effect of oxygen upon zinc immersed in potassium chloride solutions, and shows that the action cannot be completely explained by the difference in oxygen concentration which had been postulated in the 'differential aeration' theory. Zinc hydroxide plays an important part in the reactions, both in a thin film which adheres closely to the metal and is impervious to oxygen and zinc ions, but not to electrons, and in the loose masses which appear, and do not completely stop the passage of oxygen.

The Protection of the Underwater Hulls of Ships.—The possibility of producing a hard smooth surface on the underwater hulls of ships which would remain smooth has long been regarded as desirable, for such a surface would lead to a great economy in fuel. This is one of many subjects touched upon in a paper on "Modern Developments in Ship Design", by Dr. J. Tutin and A. C. Hardy, contained in the January number of the *Transactions* of the Institute of Marine Engineers. The authors state that marine growths cannot in general attach themselves to hard surfaces such as glass, porcelain, and clean steel. Is it too much, therefore, they asked, to expect modern chemical research to provide an anti-corrosive composition with an ultra-hard surface? In a written communication, contained in the *Transactions*, P. Jenkins, chief chemist to Messrs. J. Dampney and Co., Ltd., stated that he thought the theory that marine growths do not adhere to hard surfaces is doubtful; in the Hancock Museum, Newcastle, is a bottle encrusted with beautiful specimens of barnacles. All paints and compositions have of necessity to contain oily matter to repel water, and such materials cannot be made very hard. It is, therefore, too much to expect chemical research to find an ultra-hard preservative for ships' hulls. The only coating of this nature which can be applied to iron is vitreous enamel, and this is impracticable for the protection of ships. Vitreous enamels are fused at high temperatures and are applicable to only relatively small objects. They are also prone to chip off.