

## Research Items.

**Cult of the Sacred Bull in Ancient Egypt.**—Mr. O. H. Myers contributes to *Discovery* for July an account of the past season's excavations carried out by the Egypt Exploration Society in the Bucheum, or burial-place of the sacred bull, at Armant, near Luxor. The Baqaria, or burial-place of the mothers of Buchis, near by, was also excavated. The Bucheum was functioning from the thirtieth dynasty to the time of Diocletian. Numerous stelæ in the Bucheum, some in situ, make it possible to assign most of the bulls to the ruler who inducted them, and in the Baqaria the evidence from a variety of sources, in conjunction with that from the Bucheum, enables the mothers of many of the sacred bulls to be identified. The Bucheum is roughly T-shaped, the base of the T being the entrance to a sloping ramp. Many tombs are situated half-way down this ramp; but the greater number are along the cross passage. In accordance with Egyptian idiosyncrasy, the earlier tombs are well-made solid sarcophagi cut from one stone and well spaced, but they degenerate through a stage of well-built sarcophagi of neatly dressed blocks to badly dressed blocks and finally to burials in the passage itself. A series of stelæ ranging from the time of Darius III. to Diocletian alleges a personal interest in Buchis on the part of the rulers, including the Roman emperors, and it is stated with doubtful credibility that Cleopatra VI. herself brought the bull up the river from Karnak for his induction. The site has proved disappointing in the matter of the objects found. A Nemes vase in green faience inscribed "Beloved of Osiris Buchis the King Nekht-Hor-Heb" and a fine group of bronzes, including two inscribed situlæ and a Kebeh vase, and stone and faience amulets are the most notable. A good corpus of pottery has been constructed.

**Spermicidal Power of Chemical Contraceptives.**—Effective birth control by means of chemical contraceptive agents must depend upon their spermicidal power and their mode of application, and such agents must be non-toxic and non-irritating, at least in the concentrations employed. The spermicidal power of chemical contraceptives upon guinea-pig sperms has been the subject of an investigation by Mr. J. R. Baker on behalf of the Birth Control Investigation Committee (see *Jour. Hyg.*, vol. 31, No. 2, April 1931, p. 189). Full details of the technique employed are given, and some comparative experiments indicated that guinea-pig sperms seem to react to spermicides much in the same way as human ones. The killing concentration of 36 substances was determined, this being defined as the lowest concentration in the series 2, 1, 1/2, 1/4 per cent, etc., which suffices to kill every guinea-pig sperm suspended in a special glucose-saline solution (simple saline is unsuitable) in half an hour at body temperature in four consecutive experiments, and the following figures are the killing concentrations per cent. Mercuric chloride and formaldehyde were the most active, 1/256; hexyl resorcinol, 1/64; soaps, 1/32; potassium permanganate, 1/16, and phenol, 1/2. Acetic and lactic acids, 1/32, and citric acid, 1/16; it is the concentration of hydrogen ions which determines the activity of acids. Some of the commonly used contraceptives are relatively inactive; thus, quinine hydrochloride and sulphate, and chinisol, only act at 1/2, while boric acid, magnesium sulphate, and alcohol fail to kill at 2 per cent. Certain very poisonous substances, such as potassium cyanide, prussic acid, and strychnine hydrochloride, have very slight spermicidal power, and active disinfectants are not neces-

sarily good spermicides. Foaming mixtures containing tartaric acid and sodium bicarbonate, as in effervescing pessaries, seem to be active without the addition of a spermicide, and could probably be used alone as contraceptives. Details are given of the structure of the guinea-pig sperm and of the effect of changes in osmotic pressure upon it. Spermicides generally act upon the acrosome in the head of the sperm, and it either becomes shrunken and distorted or swells and bursts. The characters for an ideal chemical contraceptive are formulated.

**Air-pressures upon a Bird's Wing.**—A very remarkable photograph of a Montagu's Harrier about to land at its nest is reproduced in *British Birds* (June 1931). The upper wing-coverts are ruffled up as if by a breeze blowing from the rear of the bird. Lieut. R. R. Graham, in a short article discussing the photograph, supplements his earlier descriptions of the part played by the feather-arrangements in the wing in regulating air-pressures upon the wing (*British Birds*, June and July 1930). The wing is in a 'stalled' condition, held flat against the air-stream, with the result that eddies of air swirling round the hind margin into a region of reduced pressure, have actually blown up the feathers from behind. The photograph also shows the tips of the primary feathers separated, so that they form a 'slotted' device, comparable to the Handley-Page slot in aeroplanes, which adds greatly to the efficiency of the wing-tips by smoothing out the air-stream passing over the fore margin of the wing.

**Transformation of Scales in Goldfish.**—In order to discover what changes take place in scales transplanted from any part of the body to the lateral line, Yasumasa Mori has carried out a series of experiments upon goldfish (*Jour. Fac. Sci. Imp. Univ. Tokyo*, Sect. 4, vol. 2, p. 185; 1931). Lateral line scales were pulled out, and in their places scales from an area outside the lateral line were inserted. It was found that the transplanted scale becomes a lateral line scale, acquiring all the organs of the lateral line, a bony sheath, a sense organ in the lumen, a nerve regenerated from the torn stump of a branch of the lateral nerve, blood-vessels, and a pore penetrating the scale. The growth of the new structures generally commences beneath the pore of the preceding scale, and where a series has been transplanted the anterior individual acquires the new organs much more rapidly than those posterior to it. The whole process of transformation generally takes about two months, but in very rapid cases complete transformation has been observed in one month.

**Symbiosis of Fungus and Scale Insect.**—The relations between the fungus *Septobasidium retiforme* and the scale insect *Aspidiotus osborni* are discussed by J. N. Couch (*Quart. Jour. Micr. Sci.*, vol. 74, pt. 3, 1931). The fungus forms flat patches on the bark of oak and other trees in North Carolina and is entirely superficial, never penetrating the tissues of the tree. Such patches provide a home and protection for the scale insects, which suck the juices of the host plant, grow, and finally reproduce their young in vast numbers. These young may settle down beneath the same fungus under which they were born and repeat the cycle, or they may crawl out to other fungus-insect colonies, or settle on clean bark. These last are responsible for the dissemination of the fungus. Some of the young become infected with the fungus soon after they are born, the infecting fungal cell or cells entering the circulatory



system and there developing numerous coils which absorb food from the insect. A number of the insects are finally killed and used up by the fungus; others, though infected, may digest the fungal haustoria and survive to reproduce. While the fungus within the insect's body has been developing, the hyphal threads which make up the fungal floor of one of the patches have more or less overgrown and covered the insect's body. As soon as the insect moults the second time the fungal threads which have grown over its body from the floor pass under the moulted skin, and coiled hyphæ from within the insect's body anastomose with the hyphæ outside. Thus a colony of *Septobasidium* is not descended from a single spore but is composed of many strains. The thick roof of fungus affords protection to the scale insects against extremes of temperature, against drying and the attacks of parasitic hymenoptera. The association of fungus and insect is regarded as symbiotic.

**Oranges and Arsenates.**—The chemical changes observable in ripening oranges during the last hundred days of their growth have recently been studied in some detail by Copeman (*Trans. Roy. Soc. S. Africa*, 19, 107; 1931). Particular attention has been paid to the contrast between normal oranges and those from trees which had been sprayed with lead arsenate to combat the attacks of insect pests. The general results agree in showing an increase in soluble solids in the juice during ripening, and this includes nitrogen, ash, and also sugars. Of the latter, sucrose, glucose, and fructose appear to be in equilibrium during this stage of development, since their relative proportions remain constant although the total amounts increase. Acidity, however, progressively decreases, and this decline is much more marked in fruits from trees receiving arsenate sprays. The oranges from sprayed trees thus have a characteristically insipid flavour owing to their low acid content. The effect is considered to be due chiefly to an intensification of respiration produced by arsenates; and since the effects of arsenates are metabolic in character, variations in the mode of application of the spray are not likely to remove the deleterious effects. New methods of combating insect pests in citrus culture must therefore be sought.

**The Origin of Acid Igneous Rocks.**—The problem of the association of acid and basic rocks (for example, granite with gabbro and rhyolite with basalt) is discussed from a new point of view by Prof. A. Holmes in the *Geol. Mag.*, June 1931. It is pointed out that inside the oceanic province bounded by the circum-Pacific belt, granites and rhyolites are totally lacking, and that these rocks are produced only where pre-existing acid rocks occur of the types that characterise the continental blocks. The distribution of the cone-sheets of such British Tertiary centres as Mull and Ardnamurchan makes it clear that the magmatic reservoirs from which they were fed rose to within three miles of the surface; that is to say, the reservoirs invaded the granite shell through a thickness of four or five miles. Consideration of the problem of what happened to the granitic material that previously occupied the place of the reservoirs leads to the conclusion that it became fused in situ. A source for the necessary heat is found in the upward transfer of heat by convection currents within the deeper basaltic portion of each reservoir. It is shown, by comparing the thermal gradient maintained by convection with that expressing the rise of fusion point with depth, that temperatures well above the fusion point can be reached in the upper part of a reservoir, thus providing an excess of heat, which becomes available for fusing the rock-material of the bounding

walls and roof. It is also pointed out that the operation of convection is fatal to the possibility of deriving a granitic differentiate from a parental basaltic magma, though it is not denied that in appropriate circumstances, where convection does not operate, such differentiation may be locally achieved.

**Fluctuations in Cosmic Radiation.**—It has been reported at various times that the intensity of the cosmic radiation is not constant, but that it depends upon meteorological and extra-terrestrial conditions. A discussion of a number of the supposed fluctuations, based partly upon new measurements of high accuracy made by himself by an ionisation method, is given by G. Hoffmann in the issue of the *Zeitschrift für Physik* for June 13. There appear to be definitely at least two distinct influences of major importance, one being effective with the more penetrating components of the radiation, and the other with the weaker components, which are cut off by putting a relatively thin shield over the apparatus. With the harder rays, there is a pronounced inverse dependence upon the barometric height; when the graphs for the intensity of this radiation and the barometric pressure are plotted suitably on the same time base, one is closely the mirror image of the other. Presumably it is a question of absorption of radiation of extra-terrestrial origin in the atmosphere, although, as Millikan has pointed out, the dependence upon pressure also involves the temperature of the air. For the more easily absorbed rays, the new measurements of Hoffmann show a variation with the temperature of the air; their intensity increases with increase in temperature, a fluctuation of about ten per cent of the total ionisation going with a change in temperature of ten degrees. This could possibly be connected with movement of emanation and radioactive material in the air, but no correlation between the amount of the soft radiation and the direction or strength of the wind was found. Hoffmann remarks that the problem of establishing unambiguously a dependence of the intensity of the radiation upon sidereal time is a very difficult one.

**Propagation of Electromagnetic Waves.**—Interesting speculations as to the laws governing the propagation of wireless waves are given by Prof. H. Nagaoka of Tokyo in a paper published by the Institute of Physical and Chemical Research, No. 297 (April 1931, Tokyo). He points out that the presence of a highly ionised layer in the upper atmosphere—the Kennelly-Heaviside layer—has for a long time been assumed as a working hypothesis to explain the phenomena of transmission. It is now generally believed to consist of two or even three layers at different heights. It merely indicates that the number of free electrons varies at different heights in the atmosphere. The reflection of the waves at the bounding surface between gases is not so sharp as that between solids. The wave path turns round sharply, passing through an apex. He proves that at the apex where the wave begins to bend downwards the electron density is proportional to the square of the frequency. The density of electrons varies with the altitude of the sun, and is therefore a function of the latitude as well as of the solar declination. If observations were made for a year in different stations scattered over the world, the nature of the distribution of electrons in the upper atmosphere could be determined. The problem calls for international co-operation. To explain the presence of silent zones in short-wave transmission it is necessary to assume two conducting layers. The electron density which determines the wave-path varies for several reasons. The number of electrons coming from the sun and reaching the earth's



atmosphere is much affected by the number of sunspots, by auroral displays, and magnetic storms. The day and night variation can be satisfactorily explained, but sunrise and sunset fading needs further study. Auroræ are a great hindrance to wireless working, as they produce sudden and violent changes in electron density. Meteoric showers have a much smaller effect. Reasons are given for supposing that helium plays an important part in forming conducting layers. There are many natural gas springs in America that have been emitting helium for countless generations.

**Production of High Vacua.**—For many years certain materials have been used in lamps and vacuum tubes for removal of traces of gas, these being known as 'getters'. Two classes of getters are in use: (i) Those acting as adsorbents (active charcoal, copper oxide, thoria, etc.), (ii) those having great chemical activity (alkali metals, alkaline earth metals, phosphorus). Phosphorus is generally used in lamps. In the May number of the *Journal of the American Chemical Society*, Andrews and Bacon describe comparative experiments on the efficiencies of calcium, barium, magnesium, sodium, and phosphorus, deposited as thin coatings on the walls of bulbs or tubes, from the point of view of the attainment of vacuum. They report pressures of about  $10^{-7}$  mm., the lowest measured pressure yet reached by other workers in the laboratory (of the General Electric Company) being less than  $5 \times 10^{-9}$  mm. in a gauge connected with a large tube of well degassed charcoal immersed in liquid air. The main result of the present experiments was that differences in the previous treatment of the getters are of far greater importance in the

removal of gas than differences among the getters themselves. Poorly degassed materials absorb residual gas slowly and reach equilibrium at higher pressures than those attained by more gas-free material. These pressures do not depend on temperature in the range  $0^{\circ}$ - $90^{\circ}$ .

**The Oxidation of Iodide by Persulphate.**—A study of the velocity of oxidation of iodide by persulphate ion, described by King and Jacobs in the May number of the *Journal of the American Chemical Society*, is of interest both from the point of view of experimental technique and the Brønsted theory of reaction velocities as correlated with the Debye-Hückel theory of ion activity. Instead of titrating the iodine liberated, the authors added a small amount of thiosulphate and determined the time of first appearance of iodine by a photoelectric cell circuit with a long absorption cell of solution. This permitted the use of very dilute solutions, to which alone the theoretical equation could be expected to apply. Agreement with a linear curve of the logarithm of the velocity constant plotted against the square root of the ionic strength, as required by theory, was found up to the value 0.06 of the abscissa. Above this, there was an increasing negative deviation. When the ionic strength is made up largely of univalent ions, the best straight line extrapolates to  $\log k_0 = -1.075$ , whilst with a large proportion of bivalent ions it extrapolated to  $-1.06$ . The difference is considered to be significant, though small, and it may be due to the inaccuracy of the Debye-Hückel equation for bivalent and trivalent ions, even in very dilute solutions. This deviation has been previously found, and can be qualitatively explained.

### Astronomical Topics.

**Tree-Rings and the Sunspot Cycle.**—The researches of Dr. A. E. Douglass on the correlation between the growth-rings in trees and the sunspot cycle have given a probable sunspot curve for many centuries. A *Science News Bulletin* issued by Science Service, Washington, D.C., dated June 23 announces a further development of his work. He has carried the study of the rings in certain districts back to the date 700 B.C.; by examining the timbers in some ancient Indian buildings he was able to give the dates when the trees were cut, and thus to date the buildings. Dr. Antevs, of the University of Stockholm, has found correlation between the structure of clay layers in ancient lake-beds and the sunspot cycle. Both the tree-rings and the clay layers are supposed to depend directly on the rainfall, so it is really the latter that is correlated with the sunspots.

The work of both Dr. Douglass and Dr. Antevs has been honoured by the award of Research Corporation prizes, given through the Smithsonian Institution.

**The Distance of Nova Pictoris.**—The April issue of *Mon. Not. Roy. Ast. Soc.* contains a paper by Dr. Spencer Jones, giving the details of this investigation. Direct trigonometrical measures gave the negative parallax  $-0.009''$ , with a probable error of  $0.007''$ . This could only be taken as an indication that the distance is very great. An estimate was reached on the assumption that the increase of light was due to an expanding shell or series of shells of gas emitted by the star. The rate of expansion is assumed to have been uniform between the outburst and the maximum of light; it is also assumed that the effective temperature did not vary during this period. The rate of increase in the radius per day was calculated as 5.77 times the original value, while the spectroscope indicated a velocity of approach of 65 km./sec., which becomes 77 on allowing for the recession of the centre, which is 12 km./sec.

Allowing for the fact that this is an integrated value over the whole disc, the parallax is deduced as  $0.0015''$ , and this value is found to be practically independent of the initial temperature. At maximum the radius would be 384 times that of the sun. The absolute magnitude is deduced as 3.15 before the outburst and  $-7.9$  at maximum.

**A Possible Cometary Observation by Bessel in 1832.**—Bessel observed an object that he described as a nebula on Nov. 8, 1832; its position for the equinox of 1825.0 was  $2^{\text{h}} 42^{\text{m}} 5.56^{\text{s}}$ , N.Decl.  $36^{\circ} 46' 46.7''$ . Many subsequent observers have found a faint star of mag. 9.3 in this place, but none of them could see any nebulosity round it; there is a note to this effect in "New General Catalogue". Prof. Schulhof suggested many years ago that there might have been a comet superposed on the star when Bessel observed it. The writer of this note has recently noticed that, if it was a comet, it may have been Tempel's comet of the November meteors. If so, the date of perihelion would have been Oct. 30, 1832, which is not very far from the date indicated by the recent calculations of the Computing Section of the British Astronomical Association. If this identity should be correct, the next perihelion passage will occur in November or December 1932. If the Bessel object was Tempel's comet, it would have been extremely near the earth at the time; the earth perturbations would probably be large enough to account for the small corrections needed by the elements to make them represent Bessel's observed position. There was quite a rich shower of Leonids in November 1832, though it was apparently surpassed by that of Nov. 12, 1833. Owing to the shift of the node, Nov. 17 is the probable date this year, and Nov. 16 in the two following years. The watch should be kept on neighbouring nights also, as it is difficult to predict the position of the meteors with great precision.