found, on the basis of reasonable assumptions about the energy distribution of the mesons created by an initially isotropic primary radiation, that the height of formation of the mesons observed at sea-level is considerably lower than that point in the atmosphere where the meson component has its greatest intensity. This indicates that the observed mesons have been created at a considerable depth in the atmosphere. The observations of the mean life-time of the mesons obtained by M. Maze is in satisfactory agreement with the work of other observers. The hypothesis of a multiplicity of mesons of different mass seems to be unnecessary.

The discussion on various aspects of nuclear physics was introduced by Mme. Joliot-Curie. By an extension of the methods of Bohr and Wheeler, and using recent experimental values for the mass defects, the stability of isobaric nuclei can be studied in some detail. It is possible to determine from the resulting curves whether the elements formed in the fission process, which give rise to the succession of β-emitting bodies, have an odd or an even mass number. The method also gives valuable information about the energy of the resulting continuous β-ray spectrum.

A review of the present stage of development of the photographic method of making visible the tracks of heavy ionizing particles was given by Dr. C. F. Powell. Suitable emulsions are able to record slow mesons as well as protons, deuterons, α-particles and heavily ionizing nuclear fragments. The energy of homogeneous groups of protons and deuterons can be determined, in the absence of serious background fog due to γ-rays, with an error of the order of ± 30 ekv., but the energy of an individual particle is subject to errors of ± 0·3 Mev. In the case of fast protons the orientation in the emulsion of the original direction of motion of the particle can be determined with an accuracy of about 1°.

Some typical results to show the precision obtained with the method were displayed, including measurements on the scattering of fast neutrons by protons and on the angular distribution of the particles resulting from the bombardment of gas targets of the light elements by beams of fast protons and deuterons from the Liverpool cyclotron. The main technical problem remaining to be solved is the improvement in the quality of the emulsions to make possible the employment of unskilled observers in the microscopic examination of the plates.

M. Frilley described experiments on the determination of the wave-length of γ-rays, with especial reference to nuclei of the actinium family, which showed that there are a number of anomalies in the internal conversion coefficients. It has long been known that certain radiations are almost totally internally converted so that they appear with vanishingly small intensity. Frilley showed that the contrary effect also exists in the case of certain γ-ray lines, which appear to produce practically no secondary electrons from the parent atom. No satisfactory theoretical explanation of this phenomena appears to have been found. Other anomalies also occur in the X-ray spectra excited in the radioactive elements during disintegration and studied by different methods. Whereas the differences $K\alpha_1 - K\alpha_2$ correspond well with our general conceptions derived from X-ray spectrography, the corresponding energy differences as deduced from measurements on the internally converted electrons indicate a bigger energy interval.

In experiments on the γ-rays from radium D Tsien, by measuring the ranges of the photo-electrons produced in the Wilson chamber, has found a radiation of 23·3 ekv. which is equal to half that of the well-known line at 46·7 ekv. The new line is thus partially masked by the second order of the main line in diffraction measurements. He also finds a radiation of 7 kev. which is of lower energy than that of the natural L radiation. Tsien stated that in the cases where one finds abnormally high intensities of the L lines, as in the case of actinium and radium D, this is probably associated with the interaction of the low-energy nuclear electrons (< 20 kev.) with the L shell of the atom in question.

J. Surugue described experiments on the study of the secondary β-rays from the actinium family which is complementary to the work of Frilley on the γ-rays.

Lecoin mentioned that certain trajectories of primary electrons from radium E show abnormally high scattering. Further experimental work on this subject is in progress.

A paper on nuclear isomerism by R. Berthelot dealt with a continuation of Pontecorvo's work on Br^{80}. The metastable level of Br has a period of 4·5 hr. The transition to the ground-level is accompanied by the emission of a quantum of energy 49 kev., which is completely converted internally, and by another of 37 kev. which is partially converted. Berthelot concludes that the metastable level is 86 kev. above the ground-level, the transition to the ground-state taking place in cascade through an intermediate level. The two radiations follow one another within a period of less than $2 \cdot 3 \times 10^{-6}$ sec. The 49 kev. radiation is, in the view of the author, a magnetic octopole, and the 37 kev. line a magnetic dipole, radiation.

In a very interesting paper by Prof. Dupouy, an account was given of an electron microscope using magnetic focusing, which gives very high resolving power. It was mentioned by the author that a new instrument, using protons instead of electrons, is in course of construction in the Collège de France, which it is anticipated will give a substantial increase in resolving power over that at present available.

RECENT EARTHQUAKES

DURING April 1945, three strong distant earthquakes were registered by the instruments at Auckland, Arapuni, Christchurch and Wellington, New Zealand. These occurred on April 15, 19 and 23, the epicentres being unknown until results are to hand from other observatories in the Pacific zone. Six earthquakes were actually felt in New Zealand during the month, the largest being on April 1 with epicentre near lat. 35° S., long. 178° W. The shock on April 7 was felt at Mapua, that on April 17 at Wairarapa and Wellington, and that on April 23 at Masterton.

During the same month, twenty-three earthquakes and tremors were registered on the instruments at Toledo in Spain. The greatest was on April 15, when an earthquake from an epicentral distance of 112·5° registered a full suite of waves, and attained a maximum ground amplitude of 50 μ on the north-south component at Toledo. *The Times* reported an earthquake felt over a wide area in the Province of Alicante on July 2, the shock being felt most strongly near Onteniente, where shocks occurred about three

years ago. There is no report of any damage, and further details of this shock are awaited from Spain.

The United States Coast and Geodetic Survey, in co-operation with Science Service and the Jesuit Seismological Association, has determined the epicentres of the earthquakes of May 19 and June 3. The former, from the readings of seismograms obtained at sixteen observatories, had an epicentre near lat. 40·2° N., long. 126·8° W., which is off northern California. The latter occurred at 13h. 05·6m. G.M.T. from an epicentre near lat. 8·3° N., long. 82·6° W., which is in Chiriqui Province, Panama.

During April, May and June nineteen earthquakes were registered on the seismographs at King's College Observatory, Aberdeen, Scotland. The strongest of these was on May 19, when an earthquake registered at 15h. 18m. 34s. G.M.T. and attained a maximum ground amplitude at Aberdeen of 20 μ on the north-south component.

At Binstead, Isle of Wight, Mr. E. W. Pollard registered eleven earthquakes during June; his machine was undergoing repairs during June 26 and 27.

CLOSURE AND PARTIAL SEPARATION OF A METALLIC CONTACT

THE problems associated with contacts between nominally clean metallic surfaces approaching and separating normally may be divided into two groups according to whether the path between the surfaces is metallic or gaseous. A paper by Dr. Alan Fairweather (*J. Inst. Elec. Eng.*, **92**, Pt. 1, No. 56; August 1945) is concerned with the first of these groups. The field of interest may be further subdivided, as it includes both the phenomena associated with nominally static contacts and those relevant to separating contacts up to the instant when the metallic path between the contacts ceases to exist.

In the first part of the paper, all the effects encountered in the change of resistance with current and mechanical pressure are shown to be predictable on the basis of the existence of contact spots. The extents of resistance changes are directly related to the mechanical pressure. A fresh technique is described, by means of which the existence of the spots may be demonstrated and a lower limit assigned to their number. The influence of the rate of current loading is examined, and further verification of the plastic character of the yielding process is furnished. The measurements described relate to one particular contact material, a platinum iridium alloy, and to one surface finish. They cover much wider ranges of pressures and voltages than are encountered in practice, and permit identification of all the significant events observable in a normal laboratory atmosphere. This range of observations is bounded only by limits at which effects cease to be those relevant to a clean metallic contact. One limit, attributable to surface films, not necessarily due to tarnishing, is encountered at very small pressures and voltages: the other appears at higher voltages which, if exceeded, result ultimately in glowing and fusion of the contact surfaces.

The second part of the paper is concerned with the unequal wear of the two members of a contact pair, termed 'selective erosion' or 'unbalanced erosion'; this is frequently accompanied by a gain of material by one member at the expense of the other. In severe cases one member may develop a large pip while the other produces a corresponding crater: the contacts may then lock together. Hitherto, experience has suggested that such pips and craters occur in a random manner and that neither seems to be associated with a particular contact polarity. The work described presents a new and simplified approach to the problem. It is suggested that, in general, and perhaps more especially when quenching is permissible, unbalanced erosion results from, or can be made to result from, two main causes: first, the molten metallic bridge joining the contacts when only partly separated, and secondly, the arc. The sense of arc erosion is always the same, independent of the metal, whereas that of bridge erosion depends on the sign of the Thomson coefficient of the metal near its boiling point. Thus, metals for which the senses of the bridge and arc erosion are the same can only exhibit one sense of erosion; but those for which they are opposite can exhibit both senses, or even none at all, depending on which effect predominates due to appropriate circuit conditions. This leads to the idea of alloys so designed as to possess a zero Thomson coefficient near their boiling point, which would therefore give equal bridge erosion of both contact members. Progress has been made in the development of such alloys. The remaining unbalanced arc erosion would then be reduced as far as possible by the use of an appropriate quench. Such alloys would, of course, have to satisfy all the conventional requirements for contact materials and, if possible, one more: even with a quench, the possibility of slight residual arcing cannot be neglected, so that it would be desirable, when selecting metals for the development of balanced bridge erosion alloys, to do so from those which do not readily support an arc.

FORTHCOMING EVENTS

Saturday, November 3

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Meeting of British and Austrian scientists in support of the restoration of Science in Austria.

Monday, November 5

FARMERS' CLUB (at the Royal Empire Society, Craven Street, Strand, London, W.C.2), at 2.30 p.m.—Prof. T. Dalling: "Sterility in Cattle".

SOCIETY OF ENGINEERS (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. M. Spindel and Mr. R. T. Quinn: "Improvements on Portland Cements and Concrete—Past, Present and Future".

Tuesday, November 6

BRITISH PSYCHOLOGICAL SOCIETY, INDUSTRIAL SECTION (at the War Office Cinema, Curzon Street House, Curzon Street, London, W.1), at 1.15 p.m.—Lieut.-Colonel B. Ungerson: "Motion Study Applied to Military Problems" (with Film illustrations).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. A. Müller: "50th Anniversary of the Discovery of X-Rays", (i) "The Background of Röntgen's Discovery".

QUEKETT MICROSCOPICAL CLUB (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 6.30 p.m.—Mr. E. A. Robins: "Trawler's Rubbish".

Wednesday, November 7

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. F. Armstrong, F.R.S.: "The Influence of the Prince Consort on Science" (Inaugural Address).

INSTITUTION OF ELECTRICAL ENGINEERS, RADIO SECTION (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. R. J. Clayton, Dr. J. E. Houldin, Dr. H. R. L. Lamont and Mr. W. E. Willshaw: "Radio Measurements in the Decimetre and Centimetre Wavebands".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6 p.m.—Mr. T. W. Goodwin and Prof. R. A. Morton: "The Determination of Carotene and Vitamin A in Butter and Margarine"; Mr. J. L. Bowen, Mr. N. T. Gridgeman and Mr. G. F. Longman: "A Photoelectric Method of Assaying Vitamin A in Margarine".