

*Advances in Immunology* (Vol. I). Edited by W. H. Taliaferro and J. H. Humphrey, 1961. Pp. x + 423. Price \$ 12.00.

*Immunodiffusion*. By Alfred J. Crowle, 1961. Pp. x + 333. Price \$ 10.00.

*Advances in Computers* (Vol. 2). Edited by Franz L. Alt, 1961. Pp. xiii + 434. Price \$ 14.00.

From: Addison-Wesley Pub. Co., Reading, Massachusetts, U.S.A.:

*Molecular Biophysics*. By R. B. Setlow and E. C. Pollard, 1962. Pp. xiii + 545. Price \$ 11.75.

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From: Cambridge University Press, Bentley House, London, N.W. 1:

*Resonance Radiation and Excited Atoms*. By A. C. G. Mitchell and M. W. Zemansky, 1961. Pp. xvi + 338. Price 18 sh. 6 d.

*Elements of the Topology of Plane of Points*. By M. H. A. Newman, 1961. Pp. xi + 214. Price 18 sh. 6 d.

*Atomic Theory and the Description of Nature*. By Niels Bohr, 1961. Pp. 119. Price 8 sh. 6 d.

From: Pergamon Press, Ltd., Headington Hill, Hall, Oxford:

*Electromagnetic Wave Guides and Cavities*. By Georg Goubau, 1961. Pp. xvii + 656. Price £ 5-00.

*A Course of Advanced Mathematics for Technical Schools*. By N. P. Tarason, Translation Editor: B. G. Walker, 1961. Pp. 456. Price 42 sh.

*Vocabulary of Mechanics—Collective Work* 1962. Pp. vii + 190. Price £ 5-00.

## SCIENCE NOTES AND NEWS

### Award of Research Degree

The Maharaja Sayajirao University of Baroda has awarded the Ph.D. degree in Chemistry to Shri G. H. Patel, for his thesis entitled "Studies in the Synthesis of Dihydroxyquinolines, Diquinolyl Methanes (with u.v. absorption spectra) and Halogenation of Hydroxyquinolines".

### Institution of Chemists (India) Associateship Examination, 1963

The Thirteenth Associateship Examination of the Institution of Chemists (India) will be held in November, 1963. The last date for Registration is 30th November, 1962. The Examination in Group A (Analytical Chemistry) is divided into the following eleven sections and each candidate will be examined in two of them according to his choice as approved by the Council, in addition to the General—Chemistry including Organic, Inorganic, Physical and Applied—Analytical Chemistry: (1) Analysis of Minerals, Silicates, Ores and Alloys; (2) Analysis of Drugs, Pharmaceuticals; (3) Analysis of Foods; (4) Analysis of Water and Sewage;

(5) Biochemical Analysis; (6) Analysis of Oils, Fats and Soaps; (7) Fuel and Gas Analysis; (8) Analysis of Soils and Fertilisers; (9) Analysis connected with Forensic Chemistry; (10) Analysis connected with Leather Chemistry, and (11) Analysis connected with Textile Chemistry. The Examination is recognised by the Government of India as equivalent to M.Sc. in Chemistry for purposes of recruitment of Chemists.

Further enquiries may be made to the Honorary Secretaries, Institution of Chemists (India), Chemical Department, Medical College, Calcutta-12.

### Fifth Technical Convention of the Institution of Telecommunication Engineers (India)

The Institution of Telecommunication Engineers organised a Technical Convention on 13th and 14th January 1962.

Thirty-five papers were presented and discussed in the four half-day sessions into which the convention divided. The first session contained papers on ionospheric propagation, Radio Noise, Components including Solid State

**Devices**—their standards, specifications and tropicalisation. Mr. A. C. Ramchandani, Chief Engineer, All-India Radio, New Delhi, presided over the session. The Research Department of All-India Radio presented a series of papers on ionospheric investigations including analysis of some of the I.G.Y. data collected by them.

The second session was devoted to Microwave Circuits and Components. The Chairman of the session was Dr. Amarjit Singh, Deputy Director of Central Electronics Engineering Research Institute, Pilani.

In the third session presided over by Mr. C. P. Vasudevan, Director, Telecommunication Research Centre, Posts & Telegraphs Department, papers on Industrial Electronics, Systems Engineering, Computer Techniques, Television, etc., were read.

In the fourth and the last session papers on Transistor Technology, and Sound Engineering were presented. The Chairman for the session was Dr. N. B. Bhatt, Deputy Chief Scientific Officer, Defence Science Laboratory, Delhi.

The Technical Convention was attended by research workers from universities and research organisations all over the country. The Institution is considering publication of these papers in its Journal. The papers will be grouped and special issues will be brought out on specific subjects.

#### All-India Congress of Zoology, 1962

The Second All-India Congress of Zoology will be held at Varanasi from October 15 to 21, 1962, under the auspices of the Banaras Hindu University. The Congress has been sponsored by the Zoological Society of India with the assistance of an Advisory Board consisting of leading Indian zoologists. All papers intended to be presented before the Congress must reach the Office of the General Secretaries by June 30, 1962.

Further particulars can be had from the General Secretary, c/o Post-Graduate Department of Zoology, Utkal University, Ravenshaw College, Cuttack-3.

#### New Concept of the Van Allen Belt

A revised picture of the Van Allen Belt is emerging out of the data transmitted back to earth from satellites launched last year. Instead of two distinct belts of charged particles that have been envisaged up to now, there appears to be just one deep dough-nut-shaped radiation band around the earth containing an assortment of electrons and protons with energies ranging from 50,000 electron volts up to several 100 Mev., all caught in the earth's magnetic field.

The concept of two Van Allen Belts arose from the fact that the first satellites to penetrate the region carried only high energy particle detectors. The presence of particles of lower energy was discovered only when later satellites sent up to explore these regions were equipped with suitable detectors for this purpose. New results have shown that 50,000 volt electrons as well as protons with energy of several hundred thousand electron volts are found in both the inner and outer regions.

These results lead to a new conception of the earth as being surrounded by a "magnetosphere", a single radiation zone beginning 400 miles above the equator and extending out to 40,000 miles. Protons with energies up to several 100 Mev. are found out to 4,000 miles, and electrons with energies of several Mev. beyond that. Low-energy electrons and protons are encountered throughout the entire magnetosphere, by exploring vehicles, at rates  $10^7$  to  $10^9$  per sq. cm. of exposed surface per second. The outer boundary of the magnetosphere is not fixed but moves back and forth in response to the interplay of the solar wind—cloud of charged particles from the sun—and the earth's magnetic field which traps the particles to form the radiation belt. A region of great turbulence therefore marks the transition from the magnetosphere to interplanetary space.—(*Sci. American*, 1962, 206, 68).

#### Phase Transformation in BeO

T. W. Baker and P. J. Baldock, of the Metallurgy Division of the Atomic Energy Research Establishment, Harwell, report a case of high-temperature phase transformation observed in beryllia. Investigations using a high-temperature X-ray diffractometer have shown that there occurs a reversible phase transition in beryllia at about 2050° C. Interplanar spacings were recorded over the angular range 35°–140° ( $2\theta$ ), using copper K $\alpha$ . The new phase appears at  $2080 \pm 50^\circ$  C. on heating, which reverts to the usual hexagonal beryllia structure at  $1980 \pm 50^\circ$  C. on cooling. In each case the phase-change takes place over some 30° C. The high-temperature phase seems to have pronounced cubic characteristics.—(*Nature*, 1962, 193, 1172).

#### Triple Awning in Rice

Shri R. Seetharaman, Central Rice Research Institute, Cuttack-4, describes a variation in awning in rice hitherto unreported. In the  $F_3$  generation of a cross between two *glaberrima* types a plant was noticed in which one of the spikelets had three awns. The awns on exami-

nation were found to have developed as extension of three nerves of the lemma. Subsequent breeding behaviour showed that this variation is only teratological in nature. It, however, suggests that the nerves of the lemma and palea are individually capable of developing into awns but under normal conditions only the middle nerve of the lemma and occasionally the middle nerve of the palea get prolonged into awn with a general suppression of this tendency in the remaining nerves.

Incidentally, it may be mentioned that in barley which is another naturally self-pollinated crop a mutant with triple awned lemma has been described. (A teratological occurrence of double awned spikelets in rice has been recorded—see *Curr. Sci.*, 1936, 4, 739.)

### New Phenomenon in Magnetoresistance of Bismuth

The study of the galvanomagnetic properties of pure bismuth at low temperatures, ca. 2° K., and at magnetic fields above several kilooersteds, has revealed an interesting new phenomenon according to L. Esaki (*Phys. Rev. Letters*: 1962, January 1). The experiment essentially consisted in plotting the current-voltage curves in specimens of pure bismuth kept at specified low temperatures and magnetic fields.

Several specimens of cross-section 1 mm.<sup>2</sup> and length 0.5 to 5 mm. were carefully cut from pure bismuth single crystals grown by a special technique. The direction of flow of current was chosen parallel to the bisector direction between the binary and the bisectrix axes. The magnetic field was perpendicular to the direction of the applied electric field.

It was observed that the slope of the linear current-voltage curve which was small at first suddenly changed to a steep value at a certain high electric field which we may call the kink field. The kink field was magnetic-field-dependent, and it was observed that after the onset of the kink there was a considerable drop in the magnetoresistance, as much as one-fiftieth from the normal. There is a simple linear relation between the magnetic field  $B$ , and the kink electric field  $E_k$ , given by  $E_k = \alpha B$ , where the constant  $\alpha = 10^3$  volt/cm. oersted, over the whole range of the applied magnetic field.

As an explanation of the phenomenon the following may be considered: The motion of a charged particle in crossed magnetic ( $B_z$ ) and electric ( $E_y$ ) fields is classically given by a cyclotron rotation ( $\omega, r$ ) which is dependent on the mass and velocity of the particle, and a

motion of velocity  $v = cE_y/B_z$ , in the  $x$  direction, which is independent of both the particle's mass and its velocity, as well as the sign of its charge.

In the present case the velocity  $v$  comes out to be approximately  $10^5$  cm./sec. at the kink electric field. This numerical value is comparable to the velocity of sound in bismuth. This fact may suggest that a strong electron-phonon interaction occurs when the velocity  $v$  reaches this critical value. The experimental fact that the sharpness of the kink and the differential resistance beyond the kink field vary with the crystal orientation may indicate the directional dependency of the strength of coupling between the electrons and the phonons.

There is evidence to indicate that the new phenomenon is related to the establishment of acoustic standing waves built up of frequencies that resonate corresponding to the size of the specimen, in other words, the generation of coherent phonons in the crystals.

### New Calorelectric Effect

When an oxygen-coal gas flame is directed on to two electrodes kept at temperatures differing by several hundred degrees, a potential difference of several volts develops between the electrodes. By increasing the conductivity of the flame with alkali vapour and the area of contact between flame and electrodes, and by reducing the length of the current path in the flame, currents up to several amperes have been drawn from this or similar systems. S. Klein, who first investigated this effect, found that the E.M.F. depends apparently on the temperature difference between the electrodes and is essentially independent of the electrode materials and the composition of the flame gas used. However, the origin of the "calorelectric force" in such a heat-to-electricity converter remained obscure.

Cozens and von Engle of the Clarendon Laboratory, Oxford, who have theoretically investigated the phenomenon have proposed the following mechanism for the new effect observed: it is known that in flames the degree of ionization is in general far above that obtained from the Lindemann-Saha equation of thermal ionization. This is not surprising because the system is in a steady state, but not in thermodynamic equilibrium, energy being supplied by combustion and removed by thermal conduction and gas flow. As a result of the combustion reactions excited molecules are formed and electrons gain high energy by collisions of the second kind. If the flame gas

density were sufficiently low, the system would be analogous to the positive column of a glow discharge where the large random energy of the electrons causes the walls to acquire a negative potential with respect to the axis. However, because of the high gas density in flames, the mean energy of the electrons is not uniform but decreases towards the wall because the electrons lose more energy by collisions in the denser regions near the wall.

Results of mathematical analysis of heat flow near a cool conducting wall show that as the wall temperature is reduced the electrons reaching the wall suffer an increasing number of collisions and lose more energy. Thus the electrons will charge a cold wall to a smaller negative potential than a hot wall. The calor-electric effect is therefore a manifestation of the difference in wall potential between two walls of different temperature whereby the cold wall should be at a positive potential with respect to the hot wall. This, in fact, has always been observed.—(*Nature*, 1962, 193, 1170).

#### Lithium Radiation in Twilight Sky and Nuclear Test Explosions

Observations of lithium resonance lines in twilight sky have been reported from time to time. The very large intensities of the resonance line 6707.8 Å, observed in August and September 1958, have been, at least partly, ascribed to lithium artificially produced from high altitude thermonuclear explosion (*Curr. Sci.*, 1959, 28, 305). It will be of interest to know whether there was confirmation of this during the Soviet nuclear tests in September and October 1961.

In a note contributed to *Nature* (1962, 193, 1064), H. M. Sullivan and D. M. Hunten report the results of their observations on the brightness of lithium twilight which they had conducted during 1961 at the Institute of Upper Atmospheric Physics, University of Saskatchewan. The instrument used was an improved type of photometer with a red-sensitive photomultiplier, E.M.I. type 9558 B, with a tri-alkali cathode. The photometer, which was brought into operation in May 1961, was unable to detect any emission on most occasions until the beginning of October. Thus, for most of this period, the brightness was less than the threshold value of 10 Rayleighs (R.), corresponding to an emission of  $10 \times 10^6$  photons/cm.<sup>2</sup> Observations after the beginning of October showed that the brightness slowly increased from 12 to 30 R. with a sudden jump to 400 R., on November 1, then fluctuated about 200 R., and showed a second peak of about 400 R. on

November 10. The U.S.S.R. set off a series of nuclear explosions towards the end of October and early in November. Only the two largest in this series, the one of 40 megaton range on October 23, and other of 60 megaton range on October 30, appear to have injected lithium into the 80-km. region, if it is assumed that the material took about 10 days to reach Saskatoon. Alternatively, the first peak, observed on November 1, could be associated with the 60-megaton explosion with a time-delay of 2 or 3 days. The appearance of lithium depends on the height of the explosion as well as its size. Although the correlation with nuclear explosions is attractive, it still cannot be regarded as fully established. The possibility of a natural abundance peak during these months should also be explored. A calculation of Sodium/Lithium ratio showed that it fell from 8000 for October to about 800 in November, or even less at the beginning of the month.

#### Soviet Satellites to Explore the Upper Atmosphere

In accordance with the programme for exploring the upper strata of the atmosphere and the outer space the U.S.S.R. have launched a series of artificial satellites in March-April 1962. Cosmos-I was launched on March 16. The satellite was placed into orbit with a perigee of 217 km. and an apogee of 980 km. The orbital angle was 49°, and the period of revolution was 96.35 minutes.

Cosmos-II was launched on April 6. Its perigee was 211.6 km., and apogee 1545.6 km. The period of revolution was 102.25 minutes.

Cosmos-III was successfully orbited on April 24. Its period of revolution was 93.8 minutes, and orbital inclination 48° 59'. The perigee distance was 229 km. and the apogee 720 km.

Cosmos-IV was launched on April 26, on an almost circular orbit, close to the calculated one, with the following parameters: initial period 90.6 min., apogee 330 km., perigee 298 km., and inclination of the orbit to be equatorial plane 65°. After orbiting the earth for over 3 days during which time it covered a distance of some 2 million kilometres, it was successfully landed at a pre-determined point of the Soviet Union on April 29, on a signal from the earth. Research information obtained from Cosmos-IV is now being processed and studied.—(U.S.S.R. News).

#### Highly Ionized Fe-Lines in the Coronal Spectrum

Perhaps the best method of checking the ionization equilibrium of the solar corona is

provided by the spectroscopic study of the lines emitted by Fe atom at various stages of ionization. J. Firor and H. Zirin, of the High Altitude Observatory, Colorado, report the measurements of the intensity of coronal emission lines from Fe x, Fe xi, Fe xiii, Fe xiv and Fe xv. The six lines in the accessible part of the spectrum that have been studied are: Fe x 6374.51, Fe xi 7891.94, Fe xiii 10746.80 and 10797.95, Fe xiv 5302.86, and Fe xv 7059.12.

The detailed investigation of this group of lines with high dispersion and in rapid succession was made possible by the use of an infra-red image converter in conjunction with a Climax coronagraph. The observations show no tendency for iron to be concentrated in the Fe x and Fe xiv stages as has been suggested by earlier workers.

Fe xii has no lines because it has a half-filled shell ( $p^3$ ); consequently it has no spin-orbit splitting between which transitions may occur.—(*Astrophys. Jour.*, 1962, 122).

#### Anglo-U.S. Co-operation in Space Research—the S-51 Satellite

The "S-51" international ionosphere satellite, an Anglo-American experiment, is the first example of international co-operation in the use of earth satellites. The launcher, a "Delta" rocket, the telemetry and the satellite shell are American; the instrumentation is British.

The satellite was lifted off the launching pad by the three-stage Delta rocket at 18:00 hrs. GMT on April 26, from Cape Canaveral, in Florida, U.S.A. Within minutes of blast-off the vertical path of the rocket changed to a horizontal trajectory in a roughly south-easterly direction some 200 miles above the earth. Then, somewhere over the sea off South America, the satellite was injected into orbit at about 18,000 miles per hour.

About 20 minutes after launching, an operation was completed successfully to reduce the rate at which the satellite had been spinning and to deploy its solar paddles and scientific probes. This was observed to take place by radio signals received in HMS *Jaguar*, stationed off Tristan da Cunha, in the South Atlantic.

The satellite is now orbiting the earth as planned at heights of between 200 and 600 miles. It is designed to make some 5,000 circuits over a period of about a year.

The satellite is basically a cylinder 23 in. in diameter and 20 in. high, and weighs about

150 lb. Power for the instruments is derived from four paddles covered with solar cells.

The British-designed and -built instruments are intended for making, for the first time, measurements over a year in orbit on the electrical state of the high atmosphere and its dependence on the activity of the sun as observed and recorded by other instruments. Also, measurements will be made of fast cosmic particles coming in from outer space at the same time as they are being observed by high-flying Canberra aircraft based at Farnborough, Hampshire.

#### Ruby Maser as New Light Source for Raman Spectra

A radically new light source—the optical maser—with its intrinsically high intensity, extremely narrow line width and strong directionality is ideally suited to Raman spectroscopy. Already several types of optical masers have been successfully operated, including a gas maser (operating continuously at  $\lambda$  11,530 Å) and three solid state masers (pulse operated at  $\lambda$  6940,  $\lambda$  7080, and  $\lambda$  25,000 Å). Of these the ruby maser appears to be the most suitable as a Raman source at the present time. Its emission is at  $\lambda$  6940 Å, with energy output up to 1 joule (peak power about 10 kw.) and with a line width of less than  $0.01 \text{ cm}^{-1}$  for good ruby samples. The ruby maser has already been successfully used to excite the Raman Spectra of liquid  $\text{C}_6\text{H}_6$ ,  $\text{CCl}_4$ ,  $\text{CS}_2$ ,  $\text{SnCl}_4$ , and solid  $\text{CaF}_2$ . These spectra were photographed on IN plates with high speed spectrographs in effective exposure times of the order of 50 msec. Two Raman Cells were used with the liquids: one making use of total internal reflection; the other of diffuse reflection as in an integrating sphere, with illumination of the sample by the parallel beam of the maser through a small window, the scattered light being observed at right angles to the maser beam.

The future development of new optical masers operating at shorter wavelengths and of electronic detection techniques (making use of beat frequencies between the illuminating light and the scattered light) will open exciting new possibilities for the investigation of Raman spectra. [*Methods of Experimental Physics* (Vol. 3)—*Molecular Physics*, Edited by Dudley Williams, (Academic Press, New York & London), 1962, p. 154].