SCIENCE NOTES AND NEWS

Award of Research Degrees

The Andhra University has awarded the Ph.D. degree in Physics to Shri T. A. Prasada Rao for his thesis entitled "The Structure of Electronic Spectra of the Monofluorides of Antimony and Bismuth".

Osmania University has awarded the Ph.D. Degree in Chemistry to Miss Syeda Begum for her thesis entitled "The Chemistry of Some *s*-Triazoles Derived from Semi-Carbazones and Hydrazones".

Symposium on Alcohol Distillation

A Symposium on "New Developments of Chemical Industries Relating to Ethyl Alcohol, its By-products and Wastes", organized jointly by the All-India Distillers' Association and UNESCO South Asia Science Co-operation Office, will be held at the National Physical Laboratory, New Delhi, on January 19 to 23, 1963.

Following aspects of alcohol distillation will be discussed at the symposium; (1) Economy of energy means (Fuel, steam, cooling water, power); (2) Designing, construction and intensification equipment for production of ethyl alcohol and its by-products; (3) Automation and instrumentation; (4) Industrial utilization of alcohol and its by-products and wastes.

Further information in connection with the seminar can be obtained from: (1) Mr. J. Swarbrick, Director, UNESCO-SASCO, New Delhi, (2) Mr. O. N. Chandoke, Secretary, All-India Distillers' Association, H-37, Connaught Circus, New Delhi.

Ford Foundation Grant to Delhi University

The Ford Foundation has made a grant of $195,000 to the Department of Zoology, University of Delhi, India, for expanding the facilities for research and training in the field of Physiology of Reproduction over a five-year period. Dr. M. R. N. Prasad and Dr. B. R. Seshachar will be the chief investigators in charge of the programme. As part of the activity envisaged in the Ford Foundation grant, the Department of Zoology has organised a training programme consisting of a series of sixteen seminars on Physiology of Reproduction in collaboration with Dr. Sheldon J. Segal, Consultant to the Ford Foundation on Reproductive Biology. The seminars are given by scientists from India and U.S.A. The seminar series which was inaugurated by Dr. C. D. Deshmukh, Vice-Chancellor, University of Delhi, on Monday, the 22nd October, 1962, will continue till the 25th February, 1963.

Artificially Trapped Radiation Belt Produced by High Altitude Nuclear Explosion

A nuclear device in the megaton range was detonated in the ionosphere at an altitude of 320 kilometers in the vicinity of Johnston Island (16·7° N, 169·5° W) in the Pacific at 0900 U.T. on July 9, 1962. Prof. J. A. Van Allen *et al.* have presented a preliminary report of investigations made with the satellite *Injun I* of the artificial radiation belt produced by this high-altitude nuclear explosion (*see Nature*, 1962, **195**, 939).

For every kiloton fission explosion in the device, there were produced about 10^{23} fission nuclei the radioactive decay of which yielded some 5×10^{23} electrons of different energy range. Some of these electrons were injected at such pitch angles to the geomagnetic field vector that they were temporarily trapped, executing oscillatory motion in latitude along magnetic field lines and drifting eastward in longitude to form an artificial radiation belt encircling the Earth. This is the first reported case of a significant, artificial injection of durably trapped particles into the geomagnetic field since the *Argus* tests of 1958.

The present report is based on observations made with the State University of Iowa satellite *Injun I* which was designed for study of the naturally occurring radiation belts. It was launched on July 29, 1961, into an orbit with apogee 1010 km., perigee 890 km., inclination 67° and period 104 min. Three of the particle detectors in *Injun I* have supplied the data for the present study. Two of these detectors are directional (*i.e.*, their response depends on the angle at which they point with respect to the magnetic field vector), and the third is omni-directional thus providing the simplest means of mapping out the natural and artificial radiation zones.

Before the Johnston Island burst of July 9, 1962, the counting rates of the three detectors in the equatorial region were dominantly due to inner zone electrons and protons. After the event, there are three possible contributions: (*a*) from penetrating electrons from fission decay; (*b*) from decay products of neutrons produced in the explosion; (*c*) from a redistribution in space of naturally occurring trapped particles. The observed spectrum in equatorial regions seems to show that the dominant contribution is from penetrating fission-decay electrons.

Data also showed that one hour after the explosion the number of freshly injected and trapped electrons of energy $E > 1500$ keV. in the geomagnetic field was of the order of 10^{24}. The total mass of these particles which have created this intense radiation belt is therefore only of order 1 milligram.

A preliminary comparison of the *Explorer IV* data on the *Argus* (1958) shells with the present *Injun I* data on the Johnston Island shell shows that the intensity of particles in the present case was of the order of one thousand times as great.

It appears likely that the electrons artificially injected by the Johnston Island burst will continue to be present in measurable numbers for many months on the higher altitude-shells.

Light Source for Producing Self-Reversed Spectral Lines

It is well known that the presence of self-reversed spectral lines in the emission spectra of atoms greatly facilitates the problem of spectral analysis, as these lines provide valuable information regarding the ground state and other low-lying energy levels of the atom. It is also known that the spectra of rare-earth elements, besides being complicated, characteristically lack in lines of outstanding intensity and it is seldom that they show self-reversed lines even in arcs of moderate current strength. Increasing the current strength usually enhances self-reversals, but undue increase of current will generally melt the electrodes unless adequate cooling is provided.

In a paper contributed to the *Journal of Research* J. Sugar describes a convenient method for obtaining a cool, high-current arc. It consists of a pulsed arc discharge with a peak current of 75 amperes and an on-time of one millisecond per cycle. The device used as a spectral source produces numerous self-reversed lines in both the first and second spectra of rare-earth elements: TbI, YbI, YbII, TmI, TmII, UI and UII. Resonance lines are nearly completely absorbed and can be distinguished by this character.—(*Nat. Bureau Std.*, 1962, **66A**, 321.)

Gallium Arsenide Diode Produces Infra-red Radiation

The Lincoln Laboratory of the Massachusettes Institute of Technology has announced recently a new solid state device which exhibits an "optical maser-like action", and converts electrical energy into infra-red radiation with remarkably high efficiency. The device, made of gallium arsenide and operated as a diode, emits an infra-red beam that can be focussed well enough to transmit signals over line-of-sight distances up to 50 kilometres. The beam intensity responds to variations in the input electrical signals as fast as 100 Mc./sec. With this band width it could accommodate 20 *tv* channels or 20,000 telephone circuits. When perfected, the diode will have important applications in communications.

The gallium arsenide diode does not emit coherent radiation. Nevertheless, the beam can be focussed sharply by conventional optical means. The wavelengths fall in a narrow band—about 100 Å wide—at a central frequency that depends on the operating temperature. It has been found that at 77° K. when the efficiency is highest, the central wavelength is about 8600 A.

The diode is made by diffusing a spot of zinc on a piece of gallium arsenide the size of a pinhead. Current flowing through the junction raises electrons in the semiconductor to a higher energy level, and on returning to their original state and filling up the "holes" created by their absence, the electrons emit infra-red radiation.—(*Sci. Amer.*, 1962, 207, 102.)

A New Ionospheric Ledge above the F_2 Region

Satellite *Ariel*, which was launched from Cape Canaveral on April 26, 1962, carried instrumentation to measure the local ionization density along the path of the satellite. These data are stored point by point along each orbit by a tape recorder on board the satellite, and relayed by fast play-back over the telemetry link on command from a ground station. *Ariel* is, therefore, the first satellite with instrumentation and a data-recovery system capable of providing a rapid world-wide survey of the distribution of ionization over the range of altitude and latitude covered by its orbit. This, in effect, means a scan of ionization between latitudes 54° N. and 54° S. and in the geocentric altitude range of 400–1,200 km.

The electron or ionization density is measured by a new radio-frequency plasma probe which has been developed for ionospheric investigation. Significant new results have resulted from the analysis of a representative selection of the data. The following conclusions have been drawn from this analysis:

(1) The density of ionization above the F_2 region of the ionosphere falls away with increasing altitude in the range of 400–1,200 km. (geocentric), generally on a world-wide scale according to approximate diffusive equilibrium in the earth's gravitational field.

(2) There are complex variations in the ionization density in this altitude-range, both temporal and geographical, which are comparable in relative magnitude to the corresponding variations in the F_2 region.

(3) Superimposed on (1) and (2) there is very strong evidence for the existence of a further ledge of ionization at very much greater altitudes than F_2. This ledge has been observed regularly on a world-wide scale on every transit of the satellite through the altitude-range which has so far been analysed. This ledge appears as low as at 700 km. geocentric altitude during the day, and surprisingly at a higher altitude of 1,000 km. near local midnight.

A layer of ionization above the F_2 region should be readily detected by a suitable topside sounder experiment using a high-altitude rocket or satellite. Such experiments have been reported by Knecht *et al.* (*J. Geophys. Res.*, 1961, 66, 3078 and 1962, 67, 1178) who recorded anomalous scatter echoes of large intensity at various altitudes in the range 700–1000 km. These effects, which were not at the time understood, seem to be consistent with the existence of a layer having deep spatial irregularities as is now revealed by the *Ariel* data.—(*Nature*, 1962, **195**, 1143.)

Origin of the Radio Emission from Jupiter

Since the first discovery of strong radio emission from the planet Jupiter by Burke and Franklin in 1955, a great deal has been learned about the characteristics of this radiation, and various suggestions have been made about its origin although none of them have been entirely satisfactory.

The chief facts about the Jovian radio emission are: (1) The radio bursts are intermittent (the rotational period of the sources agreeing with the accepted rotational period of the planet), and most of the energy is emitted in a narrow frequency range 10–35 Mc. with a maximum intensity at 18 ± 3 Mc./sec (2) The average intensity of a burst of radiation is about 5×10^{-21} watt. per sq. metre per cycle/sec. (3) The radiation is mainly right-handed circularly or elliptically polarized (an effect which suggests the existence of an intrinsic magnetic dipole field of Jupiter). (4) There is considerable evidence to show that the Jovian broadcasts are initiated by solar particles which travel from the Sun to Jupiter with travel times varying from 1 to 10 days.

Among the theories suggested for the origin of this radio emission are: (1) lightning discharges in Jupiter's atmosphere; (2) mechanism of plasma oscillation; (3) mechanism of synchrotron radiation from solar particles spiralling in Jupiter's magnetic field. But all these mechanisms have the drawback that one expects from them radio emission over a much broader frequency range than 18 Mc. $\pm$ 3 Mc./sec.

A new suggestion for the origin of Jupiter's radio emission, which according to the authors explains the observed facts satisfactorily, has been put forward by Landovitz and Marshall. They suggest that this radio emission is a maser-like phenomenon, namely, is a decameter emission from electrons making spin-flip transitions in the perturbed magnetic field of Jupiter, and that furthermore the radio emission is stimulated as the perturbation travels through the ionosphere of Jupiter. It is suggested that impinging clouds of solar particles stimulate perturbations which in turn cause very sudden changes (ΔH) in the local magnetic field of Jupiter, in the time of the Larmor precession, so that the local population of electrons initially having an equilibrium distribution of spin orientation with respect to the local field direction is suddenly stimulated to make spin-flip transitions. The incidence of a cloud of solar particles, therefore, subjects an electron population in a static magnetic field to an oscillating magnetic perturbation causing the electron population to emit radiation at the Larmor frequency characteristic of the static field.—(*Nature*, 1962, **195**, 1187.)

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