

mena are seldom important. An impulse current fed in at one point of a buried conductor will therefore raise its potential to a maximum of about 50 kv. per kilampere of current entering the conductor.

The formation of fulgurites proves that a lightning flash can penetrate a considerable distance into the ground, and therefore a direct stroke to a conductor buried only 2 ft. below the surface is not an impossibility.

Appreciable potentials may also arise due to earth-current voltage gradients if a flash strikes the ground anywhere in the vicinity of the cable. A similar effect has recently been investigated in connexion with power-system earth faults.

The increase of potential of the ground around substations, under fault conditions, is liable to cause breakdown of the dielectric of light-current cables entering the area when the cores of these cables are maintained at substantially earth potential. The cables can be protected against this hazard by insulating the sheath from earth for a certain distance from the substation.

The authors give a simple theory of the potentials induced on the ground-surface beneath a thundercloud. The separation of charges within the cloud surface occurs relatively slowly and is not accompanied by any sudden field changes at the ground surface. An approximate expression is found for the instantaneous value of the potential of the ground surface. If  $C$  is the capacity and  $R$  the resistance to earth of the ground surface, the product  $CR$  is constant irrespective of the distribution of the conduction and displacement currents in the ground.

An experimental arrangement of apparatus is then described showing the possibility of inducing potentials on buried conductors. A 12-stage 220 kv. portable impulse-generator is fed from a 200/30,000-volt single phase transformer with variable primary voltage over a half-wave thermionic rectifier. The impulses are applied over a water resistor to a 2-ft. diameter metal plate, suspended above a bakelite cylinder filled with sand or garden earth. The crest value of the applied surge voltage is measured by means of 15-cm. remote control spheres. Embedded in the sand is a 9-in. brass disk connected to a 2.5 cm. sphere gap which is screened against the top plate and ionized by means of a mercury-arc quartz lamp.

Three different embedding materials were investigated: air-dried sand, moisture-content 0.05 per cent (by weight), specific resistance greater than  $10^9$  ohm-cm.; garden soil specific resistivity about  $10^6$  ohm-cm., and steam-wetted sand which had a resistivity of about  $4 \times 10^5$  ohm-cm.

The conclusion is drawn that for dry sand the induced voltage is purely a matter of capacitances, and is practically independent of the wave front. With garden earth no effect due to the charging stroke could be observed within the possible working range. With steam-wetted sand the potential induced by the charging stroke was measurable and was clearly proportioned to the impulse crest voltage.

The theory given and the results of the experiments suggest that potentials can be impressed on conductors buried in the ground under a thundercloud and indicate an upper limit to their magnitude.

It is suggested that a cable laid in low resistivity soil will not experience induction trouble. Considerable attention should therefore be paid to soil aridity when choosing a cable route. Whether plant growth affects the moisture content of the soil to any appreciable depth is uncertain.

## FORTHCOMING EVENTS

[Meeting marked with an asterisk is open to the public.]

TUESDAY, OCTOBER 7

CHADWICK PUBLIC LECTURE (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 2.30 p.m.—Dr. V. Zachary Cope: "The Influence of War on Surgery".\*

FRIDAY, OCTOBER 10

PHYSICAL SOCIETY (in the Physics Department of the Imperial College, Imperial Institute Road, London, S.W.7), at 4 p.m.—Prof. J. T. MacGregor-Morris: "Recent Work on the Use of Photo-electric Rectifier-Type Cells in Photometry".

## APPOINTMENTS VACANT

(not included in the monthly Books Supplement)

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LIBRARIAN—The Principal and Clerk to the Governing Body, Wigan and District Mining and Technical College, Wigan (October 8).

LECTURER IN ELECTRICAL ENGINEERING SUBJECTS at the Cardiff Technical College—The Director of Education, City Hall, Cardiff (October 8).

ASSISTANT LECTURER IN GEOGRAPHY (MAN OR WOMAN)—The Registrar, University College, Nottingham (October 13).

HEADMASTER of Stockport Grammar School—The Clerk to the Governors, Stockport Grammar School, Mile End, Stockport (October 15).

CIVIL ENGINEERING ASSISTANT—The Clerk to the River Ouse (Yorks) Catchment Board, 7 Langcliffe Avenue, Harrogate (endorsed 'Engineering Assistant') (October 15).

INSPECTOR OF SCHOOLS (WOMAN)—The Director of Education, Guildhall, Hull (October 18).

LECTURER-IN-CHARGE OF MECHANICAL ENGINEERING—The Principal, Aston Technical College, Whitehead Road, Birmingham 6.

GRADUATE LECTURER WITH QUALIFICATIONS IN MATHEMATICS, PHYSICS, OR ENGINEERING—The Principal, Technical College, Kendrick Hall, Stroud, Glos.

## REPORTS AND OTHER PUBLICATIONS

### Great Britain and Ireland

Tin Research Institute. Publication No. 105: The Spectrographic Analysis of Tin-Lead Soldiers. By D. M. Smith. Pp. 8. (Greenford: International Tin Research and Development Council.) [179]

British Rubber Producers' Research Association. Publication No. 11: Studies in the Sterol Group, 43: The Unspoonifiable Portion of the Acetone Extract of Plantation Rubber. By I. M. Heilbron, E. R. H. Jones, K. C. Roberts and P. A. Wilkinson. Pp. 4. Publication No. 12: On Measuring the Efficiency of a Tractor by its Fuel Consumption. By E. W. Russell and H. J. Hine. Pp. 13. (London: British Rubber Producers' Research Association.) [179]

### Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 139: The Soils of Tasmania. By C. G. Stephens. Pp. 40. (Melbourne: Government Printer.) [179]

Bulletin of the American Museum of Natural History. Vol. 78, Art. 2: Results of the Archbold Expeditions, No. 34: Development and Enemy Recognition of the Curve-billed Thrasher *Toxostoma curvirostre*. By A. L. Rand. Pp. 213-242. Vol. 78, Art. 3: New American Syrphidae. By C. H. Curran. Pp. 243-304. Vol. 78, Art. 4: A Study of *Orycteropus gaudryi* from the Island of Samos. By Edwin H. Colbert. Pp. 305-352. Vol. 78, Art. 5: Results of the Archbold Expeditions, No. 35: A Review of the Genus *Hipposideros* with Special Reference to Indo-Australian Species. By G. H. H. Tate. Pp. 353-394. (New York: American Museum of Natural History.) [179]

Smithsonian Institution: Bureau of American Ethnology. Bulletin 130: Archaeological Investigations at Buena Vista Lake, Kern County, California. By Waldo R. Wedel, with Appendix: Skeletal Remains from the Buena Vista Sites, California, by T. D. Stewart. Pp. viii+194+57 plates. (Washington, D.C.: Government Printing Office.) 55 cents. [179]

Smithsonian Miscellaneous Collections. Vol. 99, No. 8: Check-List of the Terrestrial and Fresh-Water Isopoda of Oceania. By Harold Gordon Jackson. (Publication 3593.) Pp. 36. (Washington, D.C.: Smithsonian Institution.) [179]

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