SOME BOTTOM CORES FROM THE SWEDISH DEEP-SEA EXPEDITION, 1947–48

THE final publication of the analyses and conclusions to be drawn from the world-wide collection of cores made by the Swedish Deep-Sea Expedition during 1947–48 is still to come. However, with the enormous amount of material collected and the wide scope of the examinations, it is inevitable that the results of particular studies made by many different workers should be published separately and as soon as completed. Thus during the past two years, five fascicules, comprising ten separate papers on sedimentation problems, have been published in the series of the Expedition reports*. Some of these papers represent exhaustive studies of particular cores, whereas others merely present briefly the results of the application of one particular technique to some core material. The cores from the different oceans of the world crossed by the *Albatross* during the Expedition are dealt with in separate volumes in the reports, all papers relevant to these cores being published in one volume, consisting of several fascicules published as the results become available.

Fasc. 4 of the volume on West Pacific cores contains four papers describing a core of 4 m. taken from a depth of 7,710 m. in the Mindanao Trough. This consists of a thin layer of sand overlying a thick bed of fine-grained terrestrial mud which in turn overlies a bed deposited by series of turbidity currents, containing graded sand layers. The principal work is described by Fredriksson, who has undertaken mechanical, chemical and petrological analyses of both the fine and coarse fractions of the core. These show that the sedimentary material has been derived mainly from the andesitic to basaltic rocks of the nearby Snellius Ridge. The breaking up process is attributed to tectonic movement and volcanic explosion, the fine material being transported by sea currents and the coarser silts and sands by mud slides followed by turbidity currents.

This conclusion is confirmed by the discovery of shallow water benthonic Foraminifera in the coarse layers in the core (Reyment) and of fragments of calcareous algae known to exist in reef-building corals characteristic of shallow water (Horn af Rantzien).

Two papers by Locher describe five cores taken in the West Equatorial Atlantic basin between the Amazon Estuary and the Mid-Atlantic Ridge. All these cores show sand and silt layers with associated beds of blue mud. Mineralogical and petrographical analyses of the heavy minerals of the cores are described and show that there are significant differences between their mineral assemblages and those of samples taken from the Amazon Estuary. The sand layers, which are rich in Foraminifera, have all the properties of turbidity current deposits and are assumed to be derived from the South American continent.

The work of Norin on a core of 18 m. from the central Tyrrhenian Sea is the most complete description of any of the cores discussed here. The core consists chiefly of a calcareous pelagic clay sparsely intermixed with aerial dust and silt. The clay minerals are shown to have been largely derived from the land mass to the east, although it is suggested that the montmorillonite is authigenic. Intercalated in the column of normal pelagic sediment are many layers of coarser and darker materials. Each of these has been studied in detail and is described with regard to its mechanical and mineralogical composition. The layers can be ascribed to three different modes of deposition, each with its own characteristic composition and formation. Eruptions of nearby volcanoes contribute volcanic glass and pumice, although it has been difficult to correlate the layers with known periods of volcanic activity. Some layers with sharp boundaries both below and above are characteristic of exceptionally severe dust storms. Very small quantities of such eolian deposits are found throughout the core. Thirdly, there are the turbidity current deposits which apparently originate on a ridge nearby. The material of these deposits is highly mixed, containing volcanic ash, Foraminifera and quartz. It is thought that the quartz is first deposited on the ridge by eolian transport and later moved by the turbidity currents. A thorough study of the surrounding land geology and of the petrography of the volcanoes in the region enables a very precise study of the origin of the sediments to be made. It is unfortunate, however, that more is not known of the topography of the sea-floor surrounding the core and that more cores are not available to correlate simultaneous deposits.

In the volume on "Special Investigations", the mineral composition of the clay fraction of two cores from the Atlantic and Pacific is compared (Dekeyser and Lippman). From the rather limited data it is concluded that there are marked differences between cores but surprising constancy throughout each core. Brotzen and Dinesen have attempted to correlate the stratigraphic sections of two Pacific cores using a statistical treatment of the foraminiferal assemblages. These appear to be controlled by climatic conditions, and warm and cold periods can be distinguished.

* Göteborgs Kungl. Vetenskaps-och Vitterhets-Samhälle. Reports of the Swedish Deep-Sea Expedition, 1947–1948.

Vol. 6. Sediment cores from the West Pacific. No. 4. A sediment core from the Mindanao Trough. By K. Fredriksson, p. 97–134. No. 5. Mineralogical composition of some <2 micron fractions in a sediment core from the Mindanao Trough. By J. Ch. L. Favejee, p. 135–138. No. 6. A Note on the Foraminifera in a sediment core from the Mindanao Trough. By R. A. Reyment, p. 139–156. No. 7. Fragments of calcareous algæ in a sediment core from the Mindanao Trough. By H. Horn af Rantzien, p. 157–160. 25 Sw. kr.

Vol. 7. Sediment cores from the North Atlantic Ocean. No. 4. Sedimentpetrografische Untersuchung der Lotkerne 255 und 257. By F. W. Locher, p. 185–208. No. 5. Ein Beitrag zum Problem der Tiefseesande im westlichen Teil des äquatorialen Atlantiks. By F. W. Locher, p. 209–225. 10 Sw. kr.

Vol. 8. Sediment cores from the Mediterranean Sea and the Red Sea. No. 1. The sediments of the Central Tyrrhenian Sea. By E. Norin, p. 1–136. 35 Sw. kr.

Vol. 10. Special Investigations. No. 2. Examinations of core 72 and 723. By W. Dekeyser, p. 33–38. No. 3. X-ray determination of phillipsite in a sediment core from the Central Equatorial Pacific. By F. Lippman, p. 39–42. 5 Sw. kr. No. 4. On the stratigraphy of some bottom sections from the Central Pacific. By F. Brotzen and A. Dinesen, p. 43–55. 5 Sw. kr.

(Göteborg: Elanders Boktryckeri Aktiebolag. 1958 and 1959.)

The correlations, however, are not striking, and there is no evidence that the cores do in fact represent continuous and undisturbed sedimentation.

Perhaps the most interesting general conclusion to be drawn from this series of papers on deep sea sediments is that it is extremely rare to find a core that does represent continuous and undisturbed sedimentation. In every core described, there is evidence of a great deal of horizontal displacement of sediments after their initial deposition, by slumps, mud slides and turbidity currents. As these are processes controlled by gravity, and taking place on the bottom, the local topography is of the utmost importance. Different physiographical regions, as defined by Heezen, will have different types of sediment deposited. Any attempt at correlation between cores must take this into account.

The work that has been carried out on analysis of the cores obtained by the *Albatross* represents, perhaps, one of the most exhaustive studies ever made on deep-sea sediments. Certainly the collection of papers provides a solid mass of accurate data to which other sediment studies can be referred and which will inevitably lead to a better understanding of the processes involved in deep-sea sedimentation.

A. S. Laughton

A RELATION BETWEEN SOLAR RADIO EMISSION AND POLAR CAP ABSORPTION OF COSMIC NOISE*

By Dr. M. R. KUNDU and Prof. F. T. HADDOCK
The Observatory, University of Michigan, Ann Arbor

IONOSPHERIC absorption of cosmic noise in polar regions (called polar cap absorption) is believed to be caused by ionization of the upper atmosphere by fast protons (in the energy-range of 10–50 MeV.) emitted from the Sun after a big flare[1,2]. Direct balloon observations of protons have confirmed this hypothesis[3,4]. It is further known that, following the associated solar phenomena, the absorption event begins after a highly variable delay of 1–50 hr. The association of some proton events with metre-wave outbursts of continuum radiation has led to the belief that cosmic-ray particles, or fast protons, are accelerated by the same mechanism as the fast electrons responsible for continuum radiation, that is, synchrotron radiation from high-energy electrons accelerated in magnetic fields in the solar atmosphere. The use of polar cap absorption as a detector of low-energy cosmic rays suggests the importance of identifying the nature of solar radio emission which might be associated with these absorption events. In this article, we intend to make a statistical study of the nature of centimetre-wave as well as metre-wave radio outbursts associated with polar cap absorption events and, if possible, to draw general conclusions regarding the prediction of the proton events.

During February 1956–July 1959, 31 events of polar cap absorption have been reported[1,2]. For the radio burst data we have used the single frequency observations of the University of Nagoya on 9,400, 3,750, 2,000 and 1,000 Mc./s., of Ottawa on 2,800 Mc./s., and the dynamic spectrum records of the University of Michigan and the Harvard station at Fort Davis in 100–600 Mc./s. band and of Sydney in 40–240 Mc./s.

Metre-wave outbursts of continuum radiation characterized by its broad-band spectrum, long duration and strong polarization is called type IV radio emission, and it is believed that broad-band centimetre-wave outbursts are also of the same nature. A centimetre-wave outburst is defined as a burst of emission having a peak intensity greater than 100 units (1 unit = 10^{-22} W.m.$^{-2}$(c./s.)$^{-1}$), and we shall define the centimetre-wave outbursts having peak intensities greater than 500 units over the entire wave-length range of 3–30 cm. as intense broad-band centimetre-wave outbursts and those having peak intensities greater than 100 but less than 500 units over the same wave-length range as moderate broad-band centimetre-wave outbursts.

Of the 31 polar cap absorption events so far reported, 28 events occurred during periods of centimetre-wave observations, and in only 18 events were there simultaneous metre-wave spectral observations. All 28 absorption events have been identified as being associated with centimetre-wave outbursts. The solar radio events associated with polar cap absorption events are intense centimetre-wave burst radiations which have a very wide spectrum, extending down to metre-waves. The burst radiation on centimetre/waves is always partially polarized and it usually lasts more than 10 min.; in some cases several hours. Simultaneous dynamic-spectrum observations made in 18 cases on metre-waves show that in the majority of the cases they are associated with type IV radio emission. The details of the association of the polar cap absorption events with the solar radio outbursts are summarized in Table 1.

Table 1. Twenty-eight Polar Cap Absorption Events (August 1956–July 1959)

Associated centimetre-wave outbursts	Associated metre-wave outbursts		
	Type IV	Type II (No Type IV)	No spectral observations
28	15	3	10

Table 1 shows that all 28 polar cap absorption events are associated with centimetre-wave outbursts. Their peak intensities are comparable over the whole wave-length range of 3–30 cm.; the spectrum is rather flat in this wave-length range.

* Since the preparation of this article, a note on the same subject (*Nature*, **185**, 89; 1960) by Drs. A. R. Thompson and A. Maxwell came to our notice. These authors discuss the relation of low-energy cosmic rays with type IV metre-wave outbursts of continuum radiation, but do not consider the centimetre-wave outburst radiation which, as discussed in this article, plays a very important part in the occurrence of low-energy cosmic ray events.