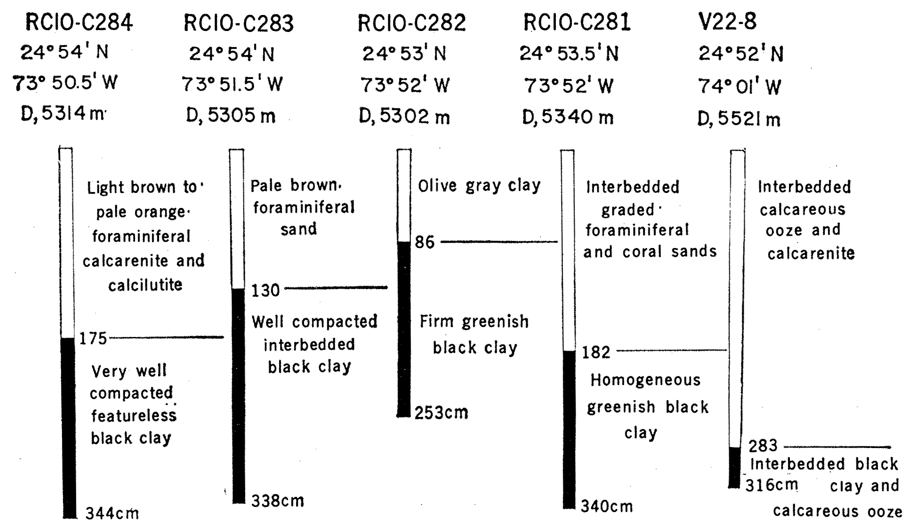

Fig. 2. Lithologic description of cores.

ranging from Upper Jurassic through Lower Cretaceous.

The probability of the assemblages being younger, reworked, marine deposits is small, on the basis of the following evidence: (i) lack of spore and pollen taxa characteristic of younger assemblages, at both the generic and species levels; (ii) occurrence of dinoflagellate and acritarch assemblages that have a closer affinity to older Cretaceous assemblages rather than younger; (iii) close quantitative identity with nonmarine and marine Middle Cretaceous assemblages on the continents; and (iv) evidence from Cretaceous coccoliths and Cenomanian foraminifers.

Study of the distribution of modern land-plant spores and pollen in the ocean basins, especially by Groot (*11*), Stanley (*12*), and Koreneva (*13*), has led to the conclusion that they are deposited relatively close to the continents. Koreneva concluded, moreover, that by 200 to 500 km offshore, the concentration of grains drops sharply from hundreds of specimens per gram to only a few, and that, by sorting or other processes, they lose all quantitative identity with the source area.

On the basis of this and other data obtained thus far from these studies, the assemblages occurring in the five cores suggest deposition in an oceanic environment much nearer a land source than is now indicated, a phenomenon that may be explained by some vertical or lateral tectonic displacement since deposition. The occurrence of thousands of grains per gram of sediment of well-preserved and quantitatively well-defined Middle Cretaceous assemblages, at considerable distance from shore, strongly supports this view. If the continental shelf were submerged through the Middle Cretaceous, the nearest source for these land-derived particles would have been at least 800 km distant.

In conclusion, palynology is held to be a valuable new tool in pre-Pleistocene deep-sea studies.

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26 September 1968

Pulsating Radio Sources near the Crab Nebula

Abstract. *Two new pulsating radio sources, designated NP 0527 and NP 0532, were found near the Crab Nebula and could be coincident with it. Both sources are sporadic, and no periodicities are evident. The pulse dispersions indicate that 1.58 ± 0.03 and 1.74 ± 0.02 × 10^{20} electrons per square centimeter lie in the direction of NP 0527 and NP 0532, respectively.*

During a general search for dispersed periodic signals, an unusual pair of pulsating sources was found in the vicinity of the Crab Nebula. They have been tentatively designated NP 0527 and NP 0532, pending more accurate measurements of position. The search was prompted by the discovery of periodic pulsed radio sources by Hewish *et al.* (*1*). The antenna was the 300-foot (90-m) transit telescope of the National Radio Astronomy Observatory (*2*), Green Bank, West Virginia. The receiver monitored the band between 110 and 115 Mhz with 50 channels, each 0.1 Mhz wide. The time constant of the receiver was 0.05 second, and all channels were sampled every 0.6 second. The output was recorded in digital form on magnetic tape.

The sources were observed during normal drift scans on 17, 19, and 21 October 1968. The beam width of the antenna (2.5°) permitted observations for 15 minutes each day. The sources become more evident when displayed in a time-frequency diagram (Fig. 1). A series of four pulses from NP 0532 and a single pulse from NP 0527 are shown; both the linear and second-order terms of the dispersion relation and also some narrow-band interference can be seen.

The apparent variations in pulse duration indicate variations in pulse strength and result primarily from the 50-msec time constant and the threshold method of display. The absence of strong variations with frequency, despite the strong variations with time, is one of the unusual characteristics of these sources, and it suggests that most of the variations may originate in the immediate vicinity of the sources. The illustrated pulses were observed with circular polarization to minimize the effects of Faraday rotation.

The stability of the pulse dispersion

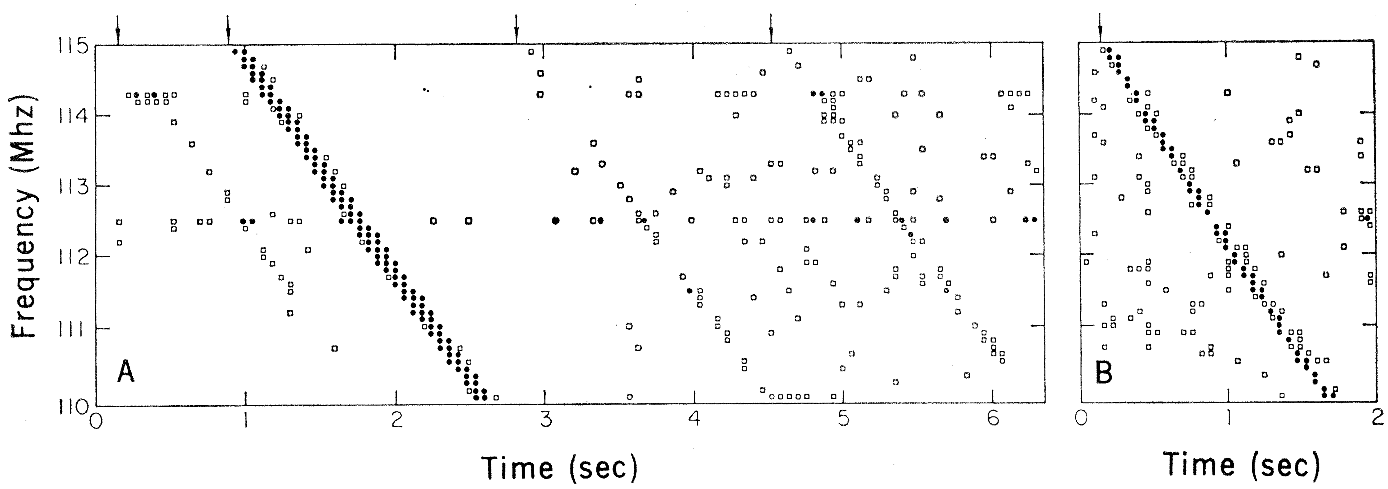

Fig. 1. Time-frequency diagram of radio pulses observed with circular polarization. (A) One strong and three weak pulses received from NP 0532 on 21 October 1968; (B) one typical pulse received from NP 0527 on 19 October 1968. Open squares and closed circles represent deviations from the mean of 4.2 and 8.3 standard deviations, respectively.

is indicated in the histogram (Fig. 2). The smaller maximum appears to be real. The separation between the two peaks is several times the experimental error, and pulses at both values of the dispersion were observed on all 3 days. The dispersion was determined for each pulse with a root-mean-square accuracy corresponding to less than 0.03×10^{20} electron cm^{-2}. The centers of the two peaks correspond to 1.58 ± 0.03 and $1.74 \pm 0.02 \times 10^{20}$ electron cm^{-2}.

Two values of dispersion could originate either from one source which has two emission modes with different ray paths, or from two separate sources. Under the assumption that the two sources are separate, they have tentatively been designated NP 0527 and NP 0532; the latter source is more active and more dispersed. The observed 1950.0 positions of NP 0527 are $\alpha = 5^h\ 27^m \pm 6^m$, $\delta = 22°30' \pm 2°$; those of NP 0532 are $\alpha = 5^h\ 32^m \pm 3^m$, $\delta = 22°30' \pm 2°$. The positions of both sources could be coincident with the Crab Nebula, located at $\alpha = 5^h\ 31^m$, $\delta = 21°58'$. An association of a pulsating radio source with a known celestial object would be very informative, and the determination of a more precise position for these sources is very important. The small angular size of the Crab Nebula would make accidental coincidence of the positions of the sources with that of the nebula highly unlikely. Such an association would support the view that pulsating radio sources may be neutron stars formed in explosions of supernovas (*3*). Scintillation mechanisms may also be responsible. If one or both of these sources are within the nebula, then still more precise measurements of position may permit one to ascertain whether there are any associations with the x-ray source (*4*), small low-frequency radio source (*5*), or central stars.

The observed dispersion of the pulsating sources is consistent with the

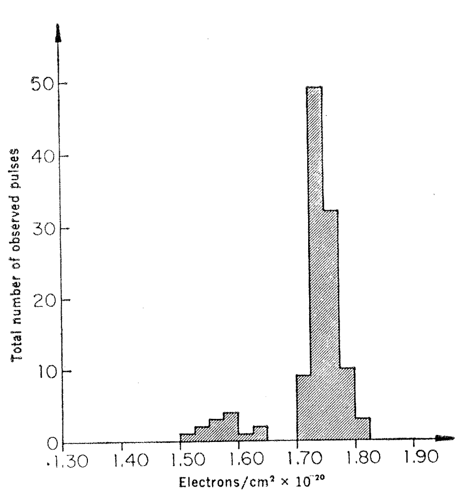

Fig. 2. Number of observed pulses at each value of dispersion. The lower dispersion peak corresponds to NP 0527; the other corresponds to NP 0532.

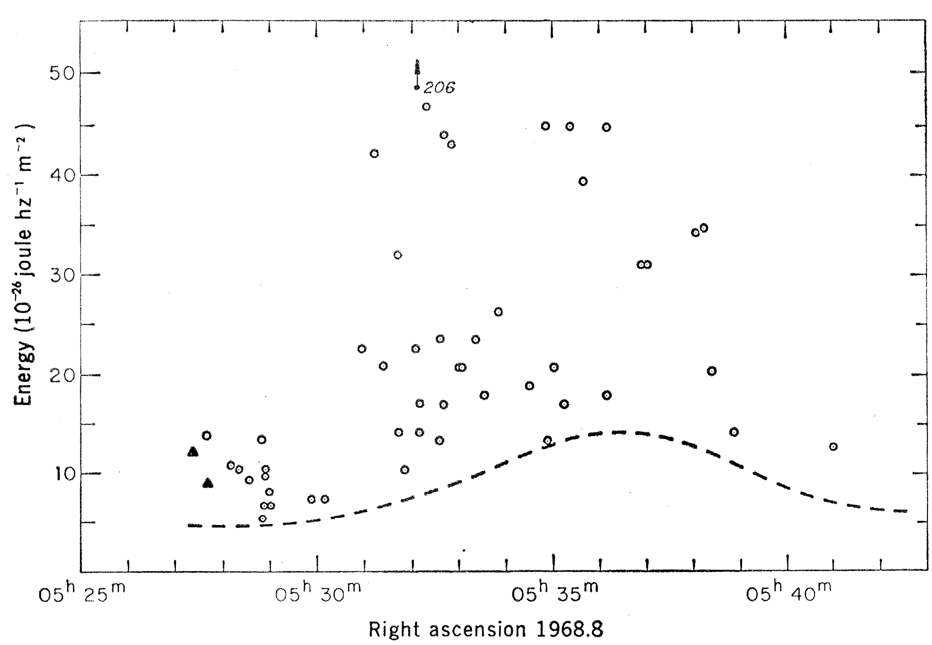

Fig. 3. Pulse energies of all pulses observed on 21 October 1968. The triangles and circles represent pulses from NP 0527 and NP 0532, respectively. The dashed line represents a detection threshold which varies with receiver noise and interference, and which was chosen to be approximately 5 standard deviations above the mean.

estimated distance to the Crab Nebula of 2 kparsec (*6*). If the sources are at this distance, then the average electron density in the interstellar medium is ≤ 0.028 electron cm^{-3} (*7*). If most of the electrons are close to the sources, then the interstellar electron density is even less.

The time variations of the sources are also unusual. The pulses tend to be isolated, although in NP 0532 they have been observed as close together as 0.21 second; NP 0527 is further distinguished by the brevity of its active periods, generally lasting no more than a few minutes during the observing period (15 minutes).

If the sources each have a unique period, then these periods must be less than 0.25 and 0.13 second for NP 0527 and NP 0532, respectively. These limits were determined by checking whether the time intervals between adjacent pulses were consistent with any single period. The upper limits on the source periods were constrained by the time resolution of the observations. If observations with greater time resolution fail to yield unique periods for these sources, they then constitute a new class of radio sources distinct from the highly periodic pulsars. In Fig. 3 are shown those pulses that were observed on 21 October 1968. No pattern is evident.

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27 November 1968

Surface Structure of Polymers: Glancing-Angle Electron Diffraction Study of Polyethylene

Abstract. *The surface regions of polyethylene nucleated and crystallized in contact with both a high-energy surface (gold) and a low-energy surface (fluorinated ethylene-propylene copolymer Teflon) have been examined by means of glancing-angle electron-diffraction techniques. Examination of these surfaces has been confined to a maximum depth of 120 angstroms. The surface region of the polyethylene generated in contact with the gold is considerably more crystalline than the surface generated in contact with the fluorinated ethylene-propylene copolymer Teflon. These results tend to corroborate recent wettability and infrared studies. Apparently, the surface structure of polyethylene is highly dependent upon the method of preparation.*

Wettability (*1*) and infrared (*2*) examination [attenuated total internal reflection (ATR)] of polymer surfaces, particularly polyethylene, have indicated that when a polymer is nucleated and crystallized in contact with a low-surface-energy phase [for example, vapor, fluorinated ethylene-propylene copolymer (FEP) Teflon, and so forth] an amorphous surface layer is generated, and when a high-surface-energy phase (for example, gold, metal oxide, and so forth) is used, a crystalline interfacial region is produced in the polymer when the melted polymer solidifies. In the above experiments, it was important to (i) provide for extensive wetting of the substrate by the melted polymer, (ii) maximize the area of the solid-liquid interface, and (iii) minimize the contribution of the liquid-vapor interface.

Since wettability determinations are confined to the outermost surface layer, the change in wettability when nucleation is initiated by a high-energy surface is attributed to a variation in surface density. Although an increase in the density of the surface layer may be interpreted as an increase in the extent of crystallinity, no direct evidence for crystallinity can be obtained from a wettability measurement. The evidence obtained from a detailed analysis of the infrared reflection of the absorption bands at 720 and 730 cm^{-1} offers firm proof that crystallinity in the surface region of polyethylene is enhanced when nucleated in contact with a high-surface-energy phase. However, since the depth of penetration of the infrared reflection experiments (*2*) is about 2 μ (*3*), considerably thicker than the surface layer (about 10 to 100 Å), we explored the possibility of using other nondestructive techniques which are confined to the surface layer (< 100 Å) to corroborate the wettability results. With glancing-angle electron diffraction, we examined the surface layer structure (about 60 to 300 Å in depth) to ascertain the extent of crystallinity.

A detailed account of the experimental variables and an analysis of the glancing-angle electron-diffraction technique is found elsewhere (*4*). An RCA-EMD-2 electron-diffraction unit operated at 50 kv was used. During glancing-angle electron diffraction, the beam is incident at angles of 0.02 to 0.1 radian. In order to eliminate prolonged exposure of the polymer film to the electron beam, we determined a proper angle of tilt on trial samples (the beam being stationary while the holder has 3 degrees of freedom). This enabled a diffraction pattern to be obtained in 2 (maximum 3) seconds.

The structure of the surface region of a high density (0.95 g cm^{-3}) polyethylene compound (Marlex 5003, Phillips Petroleum Co.) was examined. Two distinct types of surfaces were prepared. One specimen (treated) was nucleated and crystallized in contact with a high-energy surface (gold), whereas the other specimen (untreated) was nucleated and crystallized in contact with a low-energy surface (FEP Teflon). Both polymer films were prepared by being placed in contact with these surfaces for ½ hour at 200°C in nitrogen, and then being cooled slowly (1°C min^{-1}). It is important that the substrates be removed from the polyethylene by nonmechanical means so as not to damage the surface region which was generated by contact with the substrate. The gold was effectively removed by amalgamation with mercury.

The effectiveness of this method of removal is shown by the complete absence of any diffraction pattern due to gold. The FEP Teflon–polyethylene composite fell apart when cooled to room temperature. Both ATR and wet-