tion. The general assumption, that positive mesons always decay into positrons and neutrinos while negative mesons are mostly absorbed by nuclei, cannot be regarded as well founded.[6] It seems to the writer that a coupling between a special counter arrangement similar to that designed by Rasetti[7] and a cloud chamber will be suitable for this investigation.

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Velocity of Propagation of the Discharge in Geiger-Müller Counters

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AN important factor limiting the counting-rate readily achievable with counters is the time required for the avalanche to spread along the length of the central wire. When an ionizing event occurs in the volume of the counter, the electrons will be drawn toward the positive central wire. Near the central wire the electrons will acquire sufficient energy to ionize gas atoms by collision. During the chain of ionizations by collision, recombination, and excitation, photons, as well as new secondary electrons, are produced. The photons travel out in all directions, and eject electrons, thereby spreading the discharge down the length of the counter. The spread velocity of the discharge was measured by two experimental arrangements.

1. The first arrangement consisted of a counter with a divided cylinder. The main section of the copper counter cylinder was 30 cm long and 1 cm in diameter. At each end was placed another section of the same diameter, 1 cm long. The separation between the sections was less than 0.1 cm. One central wire served as anode for the three sections.

The outputs from the end sections were applied to a timing circuit.[1] The resulting pulse which represented the time interval between the discharges of the two end sections was applied to the vertical plates of a DuMont 208 oscilloscope. The background of the counter (approximately 200 counts per minute) was used as our source of impulses. This resulted in a random distribution of time intervals which were observed on the oscilloscope. The maximum time-duration resulted from a discharge initiated at one end of the counter and travelling the length of the counter to be recorded at the other end. The timing circuit was calibrated by a pulse generator giving a pair of pulses of known time separation.

A critical analysis of this experimental arrangement showed that the measurements represented the time taken by the discharge to spread along the length of the counter plus any fluctuations in the time required to collect the positive ions at the cylinder. For this reason, an arrangement designed to minimize these fluctuations was devised.

TABLE I. Velocity of propagation of the discharge.

Gas (cm of Hg)	Max. time interval	Spread velocity
	Method 1	
0.6 cm ethyl alcohol 9.4 cm argon	5.7μ sec.	5.4×10^6 cm/sec.
1.0 cm ethyl alcohol 9.4 cm argon	6.7	4.6×10^6
2.0 cm ethyl alcohol 8.0 cm argon	8.0	3.9×10^6
3.0 cm ethyl alcohol 7.0 cm argon	8.9	3.5×10^6
	Method 2	
1.0 cm ethyl acetate 8.0 cm argon	4.5μ sec.	6.2×10^6 cm/sec.

2. A second counter was constructed consisting of a cylinder 30 cm long and 1 cm diameter. Small circular probes around the central wire were made of No. 26 platinum wire, and were of 0.14 cm inside diameter. The probes were located 28 cm apart.

Pulses obtained from these probes were separately amplified by one stage of 6SJ7 tubes, then combined in a suitable differentiating network. This resulted in a double pulse with the separation between the peaks representing the travel time of the discharge. The double pulse was further amplified by a video amplifier and applied to the vertical plates of a TS-28 synchroscope. The maximum time difference between the peaks can be interpreted in terms of the time scale of the sweeps. The experimental results are summarized in Table I. These results support the theory that the positive-ion sheath spreads by photon emission and ionization. When the proportion of organic vapor is increased, the travel time should increase as the organic molecule should absorb these photons and then pre-dissociate, thus removing the photon from the chain of ionizations. The fluctuations in the time required to collect positive ions at the cylinder must be comparatively small. Our results show a slower propagation velocity than results previously reported,[2] Huber, *et al.*, having found velocities approximately 50 percent higher than the values reported here for corresponding mixtures. One serious objection to their first method is the finite width of the pulses applied to the electrical shutters inside their counter. In their second method the sharp dependence of their experimental values on applied voltage cannot be accounted for.

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Direction of Domain Magnetization in Powder Patterns

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IN the course of an investigation of magnetic domain patterns, using colloidal particles of magnetite according to the well-known techniques,[1-4] a number of new patterns have been observed, and the directions of magnet-

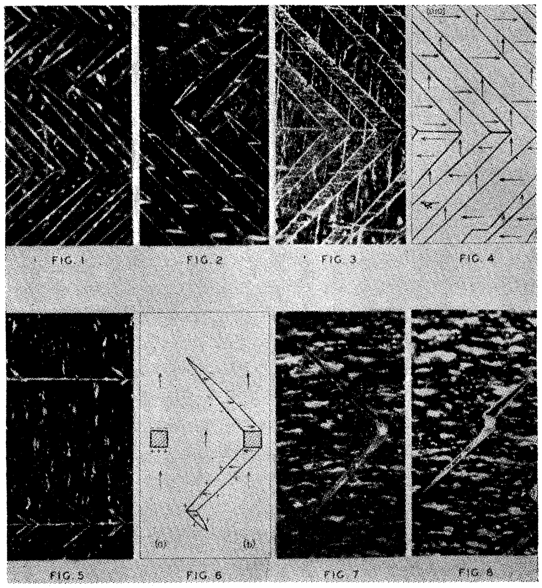

FIG. 1. Typical powder pattern on a (100) surface. Magnification about 150.
FIG. 2. Pattern on a (100) surface with a set of parallel scratches made with a ruling engine.
FIG. 3. Pattern on a (100) surface with horizontal and vertical scratches made with a glass fibre brush.
FIG. 4. Arrows indicate directions of magnetization of the domains in Fig. 3.
FIG. 5. Modification of pattern in Fig. 1 by tension, within elastic limit, applied in a horizontal direction.
FIG. 6. (a) Cavity with magnetic poles on the surface. (b) Domain formation having lower energy, proposed by Néel.
FIG. 7. Actual pattern around cavity.
FIG. 8. Pattern around another cavity.

ization in these patterns have been determined. Some of the results of the incomplete investigation are presented here.

The (100) face of a single crystal specimen of iron containing 3.8 weight percent silicon was polished electrolytically to give a strain-free surface. The pattern obtained is of a new and readily interpreted nature, and the interpretation has been checked by several new experiments. Figures 1, 2, and 3 are examples of the pattern for the demagnetized condition. The interpretation (Fig. 4 corresponding to Fig. 3) shows the domains as magnetized in the directions of easy magnetization, $<100>$ for silicon iron, with the pattern arranged so as to minimize the poles produced on the boundaries in accordance with theory.[4,5]

This interpretation is confirmed by two new experiments involving (1) scratching the surface, a technique suggested by Dr. W. Shockley, and (2) applying mechanical stress. In Fig. 2 the horizontal dashes show portions of a series of parallel continuous scratches made by a conical sapphire point and a ruling engine, and reduced in intensity by an electrolytic polish. In the tapered regions the scratches show strongly; according to Fig. 4, in these regions the flux is perpendicular to the scratch; consequently, some flux leaves the metal and attracts the colloid. Where the scratch is parallel to the flux, no field emerges, the colloid is not collected, and the scratch is faint or imperceptible. Figure 3 shows the same effect with scratches running horizontally and vertically made by a brush of fine glass wool.

Applying mechanical tension horizontally favors the horizontally magnetized domains from an energetic viewpoint since silicon iron has positive magnetostriction. When stress is applied, the tapered regions of Fig. 1 (which are unfavorably magnetized) are seen to shrink, and the pattern of Fig. 5 is obtained. On releasing the stress, tapered regions reappear. All of this confirms the interpretation given in Fig. 4.

The tapered regions of the pattern arise because the face is not accurately parallel to (100). This phenomenon, together with the effects of applied magnetic fields, will be discussed at a later date.

A further aid to the interpretation of Fig. 5 is furnished by the vertically elongated splotches. These are thought to be caused by roughness of the surface (prolonged electrolytic polishing produces a lemon-peel appearance) and act through the same mechanism as the scratches. Unlike the domain boundaries, the splotches appear always in the same place. They show up best when a concentrated colloid is used and serve, as the scratches do, to interpret direction of magnetization.

The effect of a hole in the silicon iron is shown in Figs. 7 and 8. Patterns of this kind, as shown in Fig. 6, have been predicted by Néel.[6] The magnetostatic energy caused by the concentration of poles on the surface of an inclusion (Fig. 6a) is reduced by the domain structure (Fig. 6b) which distributes the poles along the curved portions of the boundaries. As the domain elongates the magnetostatic energy decreases and the wall energy increases, and that structure occurs for which the sum of the two energies is a minimum.

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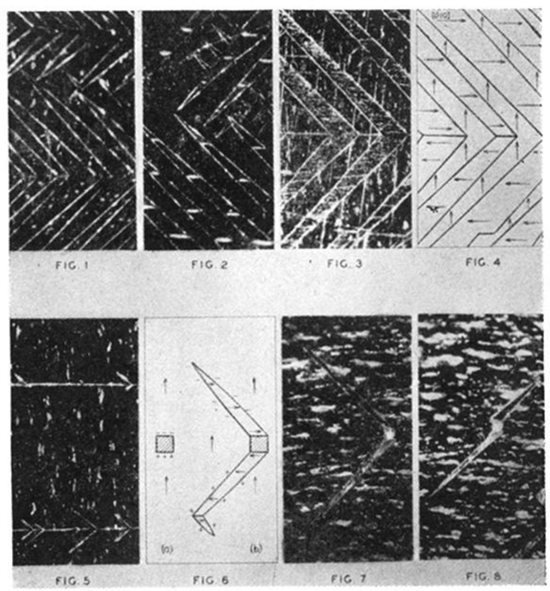

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