reflections on a frequency of 2,398 kilocycles started at 9:15 P.M., E.S.T., on August 1. At 9:20 P.M. the main reflection was observed to split into two parts (Table I). This phenomenon is rather unusual, therefore, the observations were continued until 12:15 A.M., E.S.T., on August 2. Table I is a copy of the notes taken during this period. The propagation conditions of amateur 14 mc. signals were also observed simultaneously.

The reflections from less than 1.0 km. virtual height are somewhat abnormal, having previously been observed only during severe magnetic storms and during some types of thunder storms. The splitting of the reflection into two parts, both at such very low levels, has not been observed more than 10 or 15 times during the last two years.

The Science Service Research Aid Announcement, No. 421, for the week ending on August 7, 1937, shows a slight magnetic disturbance at the Cheltenham Observatory, until midnight, August 1, and a greatly disturbed period from then until 5:00 A.M., E.S.T., August 2. It also reports an increase in sunspot numbers, from 220 on August 1 to 265 on August 2.

A tracing of the pulses reflected at about 10:00 P.M. on August 1 is shown in Fig. 1. The short narrow pulse (G) is that of the direct ray (or ground wave) attenuated by a directive antenna. C_1 is the reflection from 0.78 km. and C_2 is returned from 2.56 km. virtual height. Each division along the horizontal scale represents a time interval of 10.1×10^{-6} seconds. It will be noted that at the instant when this photograph was taken the C_1 reflection was apparently stronger than the C_2 reflection. A considerable variation in the relative C_1 and C_2 reflection strengths was noted at certain times. In some instances this variation became so rapid as to appear as a scintillating phenomenon. This same type of fluctuation has been noticed occasionally while observing only a single reflection during magnetically disturbed periods.

TABLE I

Time E.S.T.	C Region Virtual Ht. Km.		(Receiver) Loop antenna angles		Remarks
	C_1	C_2	Horiz.*	Vert.*	
9:19 P.M.	1.53	None	36°	32°	
9:20 P.M.	0.70	2.1	29°	34°	C_2 much stronger than C_1.
10:00 P.M.	0.78	2.56	21°	34°	Photograph (Fig. 1) taken.
10:27 P.M.	0.75	2.3	14°	34°	
10:31 P.M.	0.85	2.3	7°	34°	C_1 quite unsteady. 14 mc. band almost dead—fading severe. A few South American stations coming in well.
10:55 P.M.	1.5	None	197°	8°	14 mc. signals now strong and short—skip has become effective to the east—400 miles.
11:05 P.M.	1.2	None	198°	9°	14 mc. signals good from all distances.
11:12 P.M.	1.37	2.5	197°	7½°	C_2 very weak—14 mc. short skip off, and signals from different long distances points fading in and out.
12:12 A.M.	1.5	None	192°	18°	C_2 weak—14 mc. band just about dead again.
12:50 A.M.	(No readings taken)				14 mc. weak signals from all distances. 0 to 12,000 miles—no skip.
11:44 A.M.	1.6	None	190°	36°	14 mc. transmission poor.
8:30 P.M.	1.3	2.0	198°	−1°	C_2 very weak—No skip on 14 mc. band. Both local and distant 14 mc. signals quite weak.

* Relative wave polarization angles.

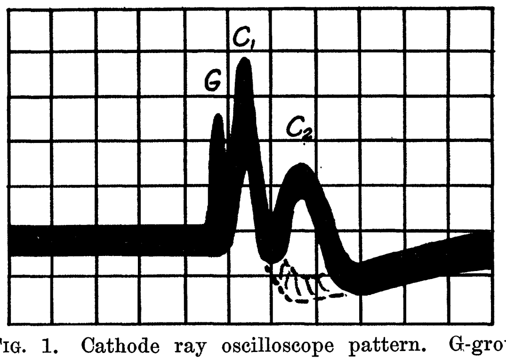

FIG. 1. Cathode ray oscilloscope pattern. G-ground pulse, C_1—first reflected pulse, C_2—second reflected pulse.

It is believed that this correlation between an aurora, a magnetic storm and a quite unusual variation in the radio signals reflected from tropospheric regions should lead to a better understanding of all these phenomena.

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INDEPENDENT CONTROL OF ALPHA RHYTHM AND "PSYCHOGALVANIC" RESPONSE

THE stimuli which have been found to block the alpha rhythm of the electroencephalogram show a superficial correspondence to those which produce the electrical or "psychogalvanic" response of the skin, *i.e.*, various sensory stimuli, "ideational processes" and startling or emotionally toned situations of almost any type.[1] It is therefore of interest to know whether the alpha block and the skin response are consistently correlated. This is of especial interest, since there has been some evidence that the alpha waves are not only of cortical origin, but may be related to the activity of subcortical nuclei which are more directly involved in emotional response,[2] and since the "psychogalvanic response" has been shown to be essentially sympathetic and also to respond to a center in the periventricular gray of the third ventricle.[3]

Simultaneous records were therefore taken on human subjects from one skin and two head electrode pairs. Silver, silver chloride cup electrodes of identical size were used for occipital and motor pairs and on the left palm for the active skin electrode. The indifferent electrode consisted of a small bore hypodermic needle placed subcutaneously in the upper arm. The skin potential response was recorded with a technique similar to that previously described[4] but using a three-stage direct current amplifier of good stability and having a 6 megohm input resistance. Brain records were made with condenser coupled amplifiers, all the records being fed into a four-element Westinghouse oscillograph. Electric shock, a 500-cycle tone, a startling buzzer and visual stimulation from opening and closing the eyes were used as stimuli.

The records show that alpha block and skin potential response are not necessarily correlated, although in many records they may appear to be so. Fig. 1 gives four sample records which illustrate the fact that varying relationships occur. It was possible to obtain definite alpha block and return without skin response, although a previous and often a later stimulus of the same type produced the skin potential variation. The record in Fig. 1 A resulted from visual stimulation.

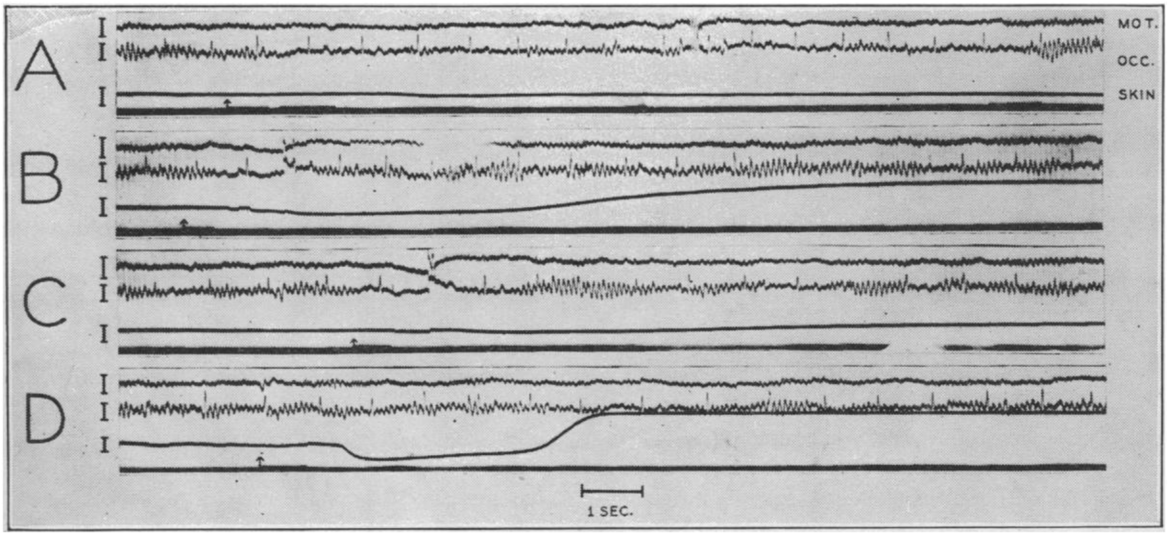

FIG. 1. Illustrative Records. High percentage alpha subject. Records = motor pair, occipital pair and skin electrodes respectively. Arrow = stimulus. Standard amplitude indicated at left, cortical records = 50 μv, skin = 1.0 mv. A—marked alpha block, slight skin response (108 μv). Eyes open at first, closed at second marker. B—short (1.44 sec.) alpha block, large (3.02 mv) skin response. Shock stimulus. C—longer (1.82 sec.) alpha block, small (230 μv) skin response. Shock stimulus. D—no alpha block, large skin response (3.12 mv). Tone stimulus.

The length of the block in some instances varied with skin potential response amplitude, but in others it did not. Fig. 1 B shows a comparatively short alpha block (1.44 seconds) and a large skin potential change (3.02 mv peak to peak) and 1 C contains a longer block (1.82 seconds) with a very small skin response (233 μv).

The previously described[4] response to a novel stimulus and ensuing adaptation occurs in the skin markedly but to a much smaller extent and sometimes hardly at all in the electroencephalogram, again indicating independence.

Furthermore, a large skin potential change may result from a stimulus which results in no alpha block. Such a record is shown in Fig. 1 D. The skin potential here was 3.22 mv peak to peak. The inde-

[1] For summary see, H. H. Jasper, *Psychol. Bull.*, 34: 461, 1937.

[2] G. H. Bishop, "Cold Spring Harbor Symposium on Quantitative Biology," 4: 316, 1936.

[3] O. R. Langworthy and C. P. Richter, *Brain*, 53: 178, 1930–31.

[4] T. W. Forbes, *Am. Jour. Physiol.*, 117: 189, 1936.

pendent variation therefore can not be due merely to a sensitivity adjustment of the D.C. amplifier too low to allow observation of a skin response occurring at small amplitude.

Independence of cortical rhythm and of the skin potential response to discreet stimuli is thus demonstrated. This would indicate that the mechanism controlling the sympathetic electrical skin response differs from that which controls or interrupts the alpha brain rhythm, although both may be simultaneously activated.

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PHYSIOLOGICAL EVIDENCE FOR THE SYNCYTIAL CHARACTER OF SMOOTH MUSCLE

COORDINATION between different parts of an organ can only be accomplished by some mechanism of conduction. Assuming that the single smooth muscle cells are units like striated muscle cells, peristaltic contractions and other coordinated movements of internal organs have usually been explained by making the ganglionic plexus, present in most viscera, responsible for coordination. However, the walls of the uterus, generally considered to be free of ganglion cells, are also capable of complicated, coordinated activity. This required the postulation of a peculiar type of conduction, which seemed to require investigation. The following observations give evidence that conduction in smooth muscle is due to its syncytial character. They also demonstrate conclusively that the excitatory processes of smooth muscle are not essentially different from those of striated muscle.

Although it is generally stated that direct electric stimulation of smooth muscle is difficult or impossible, thin strips of the longitudinal musculature of the uterus, under suitable conditions, respond to weak electric stimuli (less than 0.1 volt per cm). It is true, however, that the electric excitability of the uterus varies greatly during the sexual cycle and in a way similar to the sensitivity to drugs. The cat's uterus, for instance, is entirely inexcitable during anoestrus, but strong responses can be elicited in uterine strips prepared from animals which have previously received injections of theelin. The guinea pig's uterus is very excitable during oestrus and pregnancy, almost inexcitable during anoestrus.

The assumption that the response of the uterine strips is caused by the stimulation of nervous elements lying in the uterine wall is disproved by the fact that, in the non-pregnant uterus of the animals used, nerve stimulation only produces inhibition and by the observation that cocaine 1:200 does not abolish the response.

The possibility that some nervous plexus might be involved in the response of the uterine muscle can be eliminated by still another experiment. It has been found for nerve and striated muscle that an electric current is far less effective for stimulation if it passes at right angles than if it is oriented parallel to the fibers. In smooth muscle, on the other hand, the sensitivity would not depend appreciably on the orientation of the electric field applied, if the responses were initiated by the stimulation of a diffuse nerve plexus. It was found, however, that the threshold for electric stimuli was more than 20 times higher for a current passing at right angles than for a current passing longitudinally.

It is important that the response of uterine smooth muscle is propagated from the point of stimulation at a slow rate (0.2–5 cm per sec). Because nerve elements can not be involved in this response and because the individual smooth muscle cells are very short, it is necessary to assume that the excitation is propagated from muscle cell to muscle cell, as in heart muscle.

This conclusion is supported by some further observations. (a) The all or none relation between response and stimulus is valid. (b) The electric current has polar effects like those observed in nerve and striated muscle: On closing a current the response originates at the cathode, and anelectrotonus can be demonstrated. The different effects of the electric current on the cells near the cathode and anode can only be understood if the whole muscle is considered as one unit, comparable to a large cell. If the cells were units responding independently, all the cells between the electrodes should behave alike, since all are subjected to the same electric field.

Essentially the same results were obtained with some other smooth muscle preparations which contain ganglion cells (ureter and intestinal strips) confirming many of the old observations of Engelmann.[1]

The smooth muscles studied, consisting of innumerable small muscle cells, may be considered physiologically as giant smooth muscle cells in the same sense as the heart may be regarded as a giant striated muscle cell. This view not only explains many physiological phenomena in a simple manner, but also agrees with the findings of some histologists who have described broad anastomoses between the smooth muscle cells of visceral organs.

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[1] T. W. Engelmann, *Arch. ges. Physiol.*, 3: 248, 1870.