tex to a slightly greater extent than we did for the human cortex. Therefore, the actual difference between the indices should be even higher than that given. In order to find out the size of the error with which we were dealing, we also counted in the whale only such nerve cells as contained nucleoli. The glia/nerve cell index obtained in this manner was 5.86.

It is interesting to note that the index for the whale was consistently lower in the second cortical layer. This layer is also more cellular than the rest of the cortex, and it is possible that these two characteristics are correlated. The differences between the indices of the three regions of the whale cortex may represent consistent regional variations, or be only an accidental finding. This problem requires further investigation. We did not intend to establish absolute values, but only to compare the index for man with that for the whale.

Thus our results indicate that the increase in the number of glia cells per nerve cell is not correlated with the phylogenetic development, but with brain size. The significance of this increase is not known, but it may be suggested that it is related to the increase in the size of the nerve cells, which have longer processes and require more assistance from the supportive tissue to meet their metabolic needs. It may be of great interest for the understanding of the physiology of glia cells to determine whether one particular type of glia cell is involved in this increase.

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1 April 1957

Lack of Congenital Malformations in Normal Human Pregnancies after Transabdominal Amniocentesis

Recently considerable interest has been shown in studying human amniotic fluid. There are many references scattered throughout the literature which suggest that analysis of amniotic fluid may be of diagnostic value. Amniotic fluid may be considered as an additional body fluid compartment in the pregnant mother. Theoretically, amniotic fluid should reflect physiologic and pathologic conditions of the fetus or maternal host, or both, just as whole blood, plasma, urine, and cerebrospinal fluid indicate pathologic conditions in the nonpregnant host.

Table 1. Experience with transabdominal amniocentesis in 50 normal patients.

Gestation (wk)	Patients (No.)	Taps	
		Successful	Unsuccessful
20–24	5	5	0
24–28	8	8	0
28–32	13	12	1
32–36	13	11	2
36–40	11	10	1
Total	50	46	4

One reason amniotic fluid has not been studied extensively throughout various stages of gestation in human beings is that most physicians and investigators do not realize how easily and safely it can be obtained. Rivett (*1*) discussed the theoretical complications of transabdominal amniocentesis in human beings. More recently, Trasler and her associates (*2*) reported experimental evidence of congenital malformations in mice following puncture of the amniotic sac. They suggested that the procedure may produce similar congenital malformations in human beings.

The purpose of this report is to describe our results with 50 transabdominal amniocenteses in normal human beings during the last two trimesters of pregnancy. An 18-gage spinal needle with a trochar was used for these tests. From 15 to 25 ml of fluid was withdrawn when possible. Table 1 lists the patients by weeks of gestation and indicates the results obtained. There were 46 successful and four unsuccessful taps. The only maternal complications immediately following amniocentesis were two patients who developed infections of the urinary tract. We attribute these to faulty sterile technique in preoperative catheterization. None of the patients had premature labor precipitated by the procedure. All of the abdominal wounds healed without infection.

Each mother was followed during her prenatal course, delivery, and postnatal course. The placenta and fetus were carefully examined for evidence of trauma or other abnormalities which might have resulted from puncture of the amniotic sac. All the placentas appeared normal. The infants were all perfectly formed and were without external signs of congenital malformations. No evidence of fetal trauma was found.

The only complication was one primagravida who developed acute preeclampsia 5 weeks after amniocentesis. She experienced a complete placental separation during the thirty-fourth week of pregnancy, and the infant was stillborn. The stillborn infant had no anatomic abnormalities or evidences of trauma. Because this complication occurred such a long time after transabdominal amniocentesis, we do not feel that the procedure was a causative factor.

In our experience, transabdominal amniocentesis is a safe and easy way to obtain amniotic fluid in normal human beings during the last two trimesters of pregnancy. There was no evidence of maternal or fetal trauma. In contrast to the high incidence of congenital malformations produced by amniotomy in mice, we found no congenital malformations in human beings following transabdominal amniocentesis. Perhaps these differences are related to the stage of pregnancy when amniocentesis is performed and the ratio of fetal volume to amniotic fluid volume in various species.

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5 April 1957

Monitoring of Low-Frequency Phenomena

Many physical phenomena occur at frequencies which are generally so low that they require visual attention during monitoring or recording. Whether such phenomena are detected through their concomitant electric activity [for example, electric activity of the heart (ECG) or brain (EEG)] or through the use of electric transducers (for example, for measuring blood pressure or other fluctuating pressures), audio monitoring frees the visual attention of the experimenter for the observation of other phenomena or for the performance of other tasks. The experimenter is given a constant indication of the experiment and may be confident that he will hear any changes as soon as they happen.

A transistor regenerative oscillator was adapted from an experimental model (*1*) to convert subaudible frequencies into audio frequencies. Other transistor oscillators have been described (*2*) which could be similarly adapted. The frequency of oscillation of the oscillator varies inversely with the supply voltage.

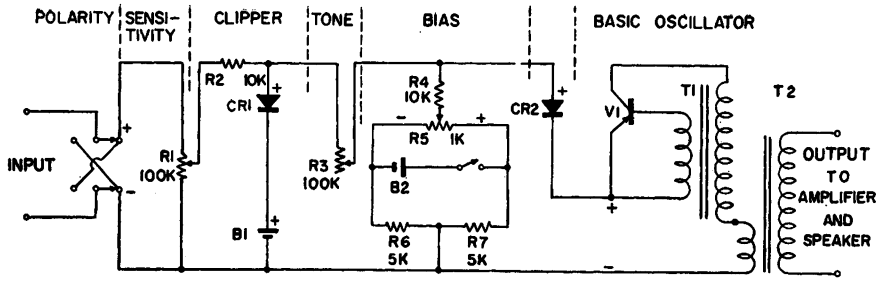

Fig. 1. Schematic diagram of frequency-modulated oscillator: K, 1000 ohms; CR1 and CR2, 1N56 high-conduction germanium diodes; V1, CK 722 p-n-p junction transistor; T1, 1/3 interstage transformer; T2, microphone transformer; B1 and B2, 1.4-v battery.

Furthermore, the power requirements are so low (a 50-μw input gives a 400-cy/sec tone) that the oscillator may be powered directly by the electric signal. Thus, amplitude variations of an otherwise inaudible signal, whether they are periodic or random in nature or even slow changes in a steady level, are translated into tonal variations. The audio-frequency tones produced may be, with experience, of great diagnostic or interpretive value. However, the device was designed as a monitor, since visual patterns are usually easier to study and interpret.

The monitor was designed to be connected across the coils of a recording galvanometer (for example, an electroencephalograph or electrocardiograph) but can be used with any other source providing more than 0.5-v input to the monitor. The output can be fed into a loudspeaker system or high-impedance earphones. The device is simple, self-contained, reliable, and inexpensive (about $10 for parts). More elaborate, but less versatile, heart monitors have been available commercially (*3*).

The basic oscillator gives an 1800-cy/ sec tone at 0.2-v input, a 200 cy/sec tone at 0.75-v input, and a 50-cy/sec tone at 2-v input. Below about 400-cy/sec, the tone is more in the nature of a pulse than the sine wave found at higher frequencies. The load on transformer T2 (Fig. 1) affects the quality of the tone. Polarity is important. If no oscillations are produced when about 1.0 v is applied to the basic oscillator, the leads of the secondary of transformer T1 should be reversed. The diodes and transistor are damaged by heat, so the leads should be kept long, and a hemostat or pair of pliers should be used as a heat sink when soldering.

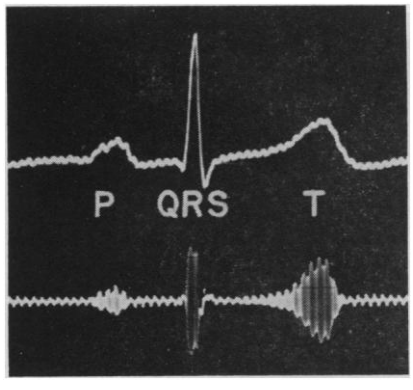

Fig. 2. Oscilloscope tracing of normal human electrocardiogram (top) with output from the audio monitor (bottom). The P wave gave a high-frequency tone followed by the QRS complex, which gave a short, low-pitched tone. The T wave gave a softer, medium-pitched, prolonged tone.

Several refinements were added. (i) A sensitivity control, R1, regulates the input voltage required for a given tone. At maximum sensitivity, 0.5 v gives an 1800-cy/sec tone, whereas 5 v are needed at mid-range, and more than 100 v at nearly zero sensitivity. (ii) A clipping circuit consisting of a 1.4-v mercury battery and a crystal diode, CR1, was added to give the device a roughly logarithmic response. This prevents the suppression of low-level components in a signal with a wide dynamic range. As an example, the QRS component of the electrocardiograph (Fig. 2) has a much higher amplitude than the P and T waves, and thus tends to overpower their tone. The T wave, however, is of particular interest because changes in amplitude or polarity indicate anoxia or heart damage. When the series resistances from R1 plus R2 and from R3 are both greater than 20,000 ohms, the signal going to the oscillator is sharply limited to about 1.4 v. (iii) Variable resistor R3 acts as a tone control for the clipped segments, such as the QRS. Thus, 1.4 v coming from the "clipper" can be set to give a tone from 300 to 2000 cy/sec. (iv) The bias network, R4 through R7 and B2, acts to suppress noise or the effects of power-amplifier imbalance by adding a negative voltage which the signal must overcome to energize the oscillator. By setting it to give a positive voltage, a steady baseline tone is produced which may then be frequency modulated by the signal. A switch is needed on B2 because of the low resistance load, whereas diode CR1 acts as an effective switch for B1. (v) The diode, CR2, rectifies the signal since the oscillator operates only with the polarity indicated (and may be damaged by currents of opposite polarity). For instance, an inverted T wave of an electrocardiogram causes a lack of tone when the bias control is set in the neutral position. A polarity reversing switch in the input circuit is a helpful addition. (vi) The transformer T2 is used to increase the amplitude of oscillator output signal and also to isolate the monitor from the speaker system, since the galvanometers of many direct-writing oscillographs are not at ground potential. Figure 2 shows how this device treats a complex input waveform by converting it to bursts of audio frequencies of different tones and amplitudes.

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29 April 1957

Boron in Morphogenesis of Plant Cell Walls

An intensive study of cell walls in celery (*Apium graveolens* L., var. *dulce* Pers.) grown under different boron levels was undertaken because of the widely recognized effects of boron nutrition on carbohydrate metabolism in plants (*1*). In addition, the extensive literature on boron nutrition includes very little information on cell-wall structure. A large body of evidence shows that, under boron deficiency, carbohydrates accumulate in the plant and in some cases new carbohydrates may be formed (*2*). There is also evidence that boron facilitates the translocation of carbohydrates in the plant (*3*, *4*), although a recent report (*5*) does not support this conclusively.

Three varieties of celery were grown in Hoagland and Arnon's solution 2 (*6*) with boron levels modified to range from 0.50 ppm (normal) to 0.00 ppm. Analyses showed that the boron content of the celery was markedly changed by the treatments. The boron content (dry-weight basis) of the petioles of Dwarf Golden Self Blanching, for example, was 36 ppm when the plants were grown at 0.50 ppm and 13 ppm when they were grown at 0.01 ppm. Measurements of cell-wall thickness and observations on