large enough in amplitude to mask the spikes.

The single fast sweeps shown in Fig. 2 are from a different squirrel and illustrate some of the spike wave forms encountered at a recording site and their persistence some 4 days later. The constant wave form and relatively constant amplitude of the matching pairs support the thesis that these are the action potentials of single and identical neurons.

Studies have so far been limited to the cells of the mesencephalic reticular formation, which are among the largest in the brain; the technique in its present form may not be applicable to all parts of the nervous system.

An observation of interest is the presence of some cells in this region which are predominantly active during sleep, with only short low-frequency bursts or no activity during the alert state. Activity evoked by visual and tactile stimuli can be recorded from this region.

The difficulty of determining the significance of a unit discharge evoked by some peripheral stimulus is obvious. For example, a single flash of light can be observed to evoke the discharge of some relatively silent units in the mesencephalic reticular formation and also to further desynchronize the cortex, alert the olfactory bulb, speed up the heart, and increase muscle tone. It would be difficult to categorize these units as being related to any of these components

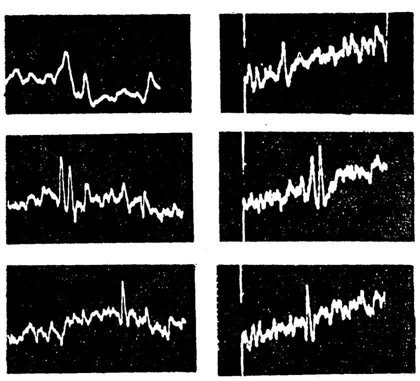

Fig. 2. Comparison of wave forms of similar spikes from one locus in the mesencephalic reticular formation, recorded 4 days apart (recordings in column at right were made 4 days later than those at left). This locus has three distinct spikes, each with a wave form which did not vary over hundreds of observations; a negative diphasic with a preliminary exponential inflection on the rising phase (top, see *3, 4, 5*); a larger negative diphasic with a tendency to fire in pairs (middle); a triphasic spike (lower). The spikes seem to fire independently of each other. Negativity, up; time of each sweep is 8 msec except for upper left, which is 4 msec; amplification of recordings in column at right is 1.3 times that on left; time constant (left), 200 msec, (right), 2 msec.

of the animal's total behavior because of the many variables of similar time course which are changing and are not being recorded. It is quite possible that the unit evoked may not be even indirectly connected with any of these components.

In conclusion, it is felt that techniques which allow the study of the behavior of neurons over a period of days are of potential value in understanding long-term phenomena in the central nervous system, including learning, memory, and recall; these techniques are now available (*6*).

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A Study of Grain Contacts in Granitic Rocks

In order to determine whether a concurrently crystallizing or previously crystallized mineral grain in a granitic rock affects the development of neighboring crystals, a study has been made of the contact relationships of minerals in thin sections of various granites. The study is based on the presumption that, if the different minerals in granites are randomly and uniformly distributed, then the percentage of contact area of a mineral *A* that is in contact with any other mineral *B* should be proportional to the modal percentage of mineral *B* in the rock. In such cases of proportionality, it may be presumed that minerals did not affect the development of neighboring grains.

For all possible pairs of minerals in the granites studied, the following ratio was measured: percentage of total contact length of all grains of mineral *A* occupied by mineral *B*/modal percentage of mineral *B*. The modal percentages were measured by point counting, and the various contacts were measured by retracing the traverses used in point counting and counting the number of times each possible contact (for example, a quartz-plagioclase contact) was crossed. Grain contacts along which albite, chlorite, or other presumably secondary minerals were concentrated were counted as contacts between the two primary minerals on either side of the secondary material.

A total of 31 granitic, quartz monzonitic, and granodioritic rocks were studied. Samples were obtained from a wide range of localities; they included Southern California batholith; intrusions in the Front Range (Colorado), intrusions in the Sierra Nevadas (California), the Idaho and Boulder batholiths, and the White Mountain, New Hampshire, and Oliverian series of New England. The average composition of these rocks is 32.3 percent quartz; 27.7 percent potassium feldspar; 32.6 percent plagioclase; 6.6 percent biotite; minor hornblende (in a few samples); and rare magnetite, zircon, sphene, apatite, and muscovite.

The results are shown in Table 1. The numbers in this table are the geometric means from all samples studied of the ratio: percentage of contact length of mineral *A* in contact with mineral *B*/modal percentage of mineral *B*. In a few samples either potassium feldspar, plagioclase, or biotite was absent, but all means represent at least 28 samples.

As shown by Table 1, many of the ratios are close to one. Statistical *t* tests of the logarithms of the ratios from each sample confirm, at the 99-percent confidence level, that the potassium feldspar-potassium feldspar and plagioclase-plagioclase ratios are less than one. None of the other ratios involving quartz, potassium feldspar, or plagioclase are demonstrably different from one. The percentage of contacts of all minerals with biotite (as the mineral *B* in Table 1) are greater than one, probably because the irregular shape of the biotite causes it to have a large surface area for its volume.

Presumably ratios close to one in Table 1 signify that the minerals involved have had little or no effect on one another's crystallization. In the case of potassium feldspar, a low ratio with other potassium feldspar grains probably indicates that growth of one feldspar crystal prevents nucleation of a similar crystal in the neighborhood. This same explanation might also apply to the low plagioclase-plagioclase ratio, but it is

Table 1. Geometric means of the ratio: percentage of contact length of mineral *A* in contact with mineral *B*/modal percentage of mineral *B*.

Mineral *A*	Mineral *B*: Quartz	Potassium feldspar	Plagioclase	Biotite
Quartz	0.84	0.99	0.95	1.60
Potassium feldspar	1.21	0.45	1.15	1.29
Plagioclase	1.04	1.06	0.72	1.63
Biotite	1.09	0.66	0.81	1.20

also possible that early crystallization of plagioclase grains causes them to be isolated from each other by later forming minerals such as quartz and potassium feldspar. Quartz, however, does not seem to affect the development of neighboring grains, and it also appears that no mineral affects the development of other mineral species (*1*).

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Note

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13 November 1957

On the Presence of 3-Hydroxytyramine in Brain

The compound 3-hydroxytyramine has attracted interest as a probable intermediate in the biosynthesis of noradrenaline and adrenaline and also as a possible neurohumoral agent. It has been shown to occur in the urine (*1*), in the adrenals (*2, 3*), and in the heart (*2*) of sheep and in the splenic nerve of the ox (*4*). The study of this compound has been hampered by lack of sensitive and specific assay methods. Apart from bioassay techniques, only the fluorimetric ethylenediamine condensation method of Weil-Malherbe and Bone (*5*) appears to be sufficiently sensitive for biological purposes. However, with this method the fluorescence spectra obtained from 3-hydroxytyramine and adrenaline are almost identical (*6*). In the fluorimetric method of Euler and Floding (*7*), the fluorescence obtained from 3-hydroxytyramine is very weak and amounts to only a few percent of that obtained from noradrenaline or adrenaline.

Recently we observed, however, that if the *p*H of samples prepared essentially according to this method was adjusted to about 5 by means of acetic acid, a fairly strong fluorescence developed. Furthermore, the activation and fluorescence peaks (345 and 410 mμ, respectively, as read in an Aminco-Bowman spectrophotofluorimeter) were at much shorter wavelengths than those obtained from noradrenaline and adrenaline, so that these compounds did not interfere, even if they were present in comparably large amounts.

Using this technique in combination with ion-exchange chromatography (Dowex 50), we have started to investigate the 3-hydroxytyramine content of various tissues. We have thus found that 3-hydroxytyramine is present in rabbit brain in an amount of about 0.4 μg/g, which is roughly equal to the amount of noradrenaline in this tissue. This may indicate that the function of 3-hydroxytyramine is not merely that of a precursor. The following criteria argue for the identity of the apparent 3-hydroxytyramine in brain with authentic 3-hydroxytyramine: (i) identical activation and fluorescence peaks, (ii) similar behavior on an ion-exchange column, and (iii) identical R_f values on paper chromatography.

Like noradrenaline (*8*), 3-hydroxytyramine is made to disappear almost completely from brain by intravenous injection of reserpine (5 mg/kg). On the other hand, the injection of the precursor 3,4-dihydroxyphenylalanine (150 mg of the DL form per kilogram, intravenously) caused a very marked increase in the 3-hydroxytyramine content of the brain (to about 2 μg/g in less than 1 hour). This was accompanied by central excitation (*9*). Both these phenomena were markedly enhanced by pretreatment with iproniazid (Marsilid). Simultaneous changes in the noradrenaline level of the brain were much less pronounced if present at all (*10*).

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4 November 1957

Upper Atmosphere Densities from Minitrack Observations on Sputnik I

The analysis of Minitrack (*1*) data on the first U.S.S.R. satellite, 1957 Alpha 2 (*2*) provides information on the density of the atmosphere (*3*) above the perigee altitude of 232 km. We find that the observed rate of change of period for Alpha 2 may be explained by a model atmosphere which is in agreement with recently obtained data on air density and temperature at altitudes (*4, 5*) up to ~200 km and constitutes a reasonable extrapolation of these measurements to higher altitudes. With allowance for the estimated probable errors in the density at 200 km and for the uncertainty in the orbit elements and ballistic drag parameter of Alpha 2, the data still yield a relatively unambiguous determination of density up to 400 km.

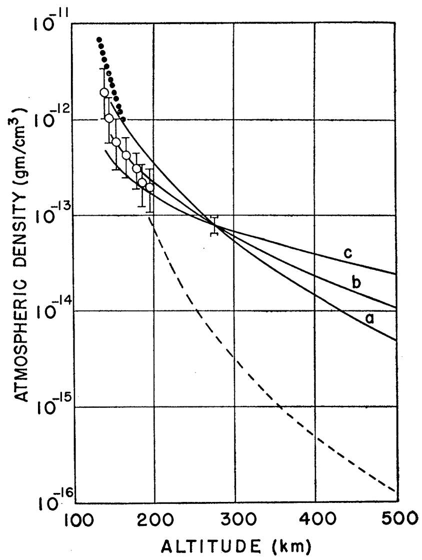

Fig. 1. Curves *a, b,* and *c* represent density distributions adjusted for simultaneous agreement with the rocket measurements and the α2 data. The dashed curve is the ARDC model atmosphere.

The determination of the density from the rate of change of the orbital period depends on the values of the ballistic drag parameter and the orbit constants of Alpha 2. The present calculations are based on a ballistic drag parameter of 89 ± 11 kg/m², derived from U.S.S.R. announcements of mass and area (*6*). The relevant orbit elements were deduced from Minitrack observations between 14 and 25 October, and their average values for that interval are as follows: perigee altitude = 232 ± 5 km; eccentricity = 0.047 ± 0.004; latitude of perigee = $39° \pm 6°$; equatorial inclination = $64.5° \pm 0.3°$; rate of change of period = 0.045 ± 0.003 min/day.

Our results are shown in Fig. 1. The solid lines represent three model atmospheres (*a, b,* and *c*) which agree with the rate of change of period of Alpha 2 and also fall within the limits of probable error in the rocket measurements of density up to 185 km. The data of Horowitz and LaGow (*4*) are indicated by circles, and the data of Byram, Chubb, and Friedman (*5*) by a dotted line. The dashed curve is the atmosphere proposed by Mizner and Ripley (*7*). The spread in the solid curves above 275 km indi-