(group 6) had smaller thyroid glands than those which received the unsupplemented diet (group 5). No goitrogenesis occurred in the group receiving the diet with PTU plus twice the amount of thyroxin present in the diets of groups 2, 3, or 4. Thus the enhancement of goitrogenesis by thyroxin is dependent on dosage.

The enhancement by thyroxin of the goitrogenic effect of propylthiouracil might be based on a possible stimulating effect of thyroxin on the growth of cells in the thyroid itself (*2*). The pituitary or other controlling centers might also require small amounts of thyroxin for the production of humoral agents. It has been suggested that more than one thyroid stimulating hormone (TSH) of the pituitary exists and that these hormones are subject to different mechanisms and exert different effects on the growth of cells and on the production of hormones in the thyroid gland (*9*).

In these experiments there is no convincing evidence supporting one of these suggestions to the exclusion of the others. Numerous factors undoubtedly influence the size, production and release of hormones by the pituitary and by the thyroid. It seems clear that the pituitary-thyroid relationship is very complex and requires further study.

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Oscillating Corticonuclear Dipole in the Basal Forebrain of the Cat

Comparison of the "spontaneous" electrical activity recorded concurrently from the hypothalamus and the surrounding basal nuclei of either cerebral hemisphere showed that all wave forms on any one record were accompanied by similar wave forms on all other records. The amplitudes of the wave forms showed continuous gradations from anterior to posterior, lateral to medial, and dorsal to ventral, suggesting the presence of potential gradients in an oscillating electric field. Extensive diathermic lesions in one half of the hypothalamus merely altered the wave forms of the activity in the necrotic region. Transection of the brain in the vicinity of the medial forebrain bundle decreased or abolished the activity. This result suggests that the electrical activity of each half of the subcortical basal forebrain is due to an oscillating field of extracellular current with the source of the electromotive force (e.m.f.) located outside the hypothalamus.

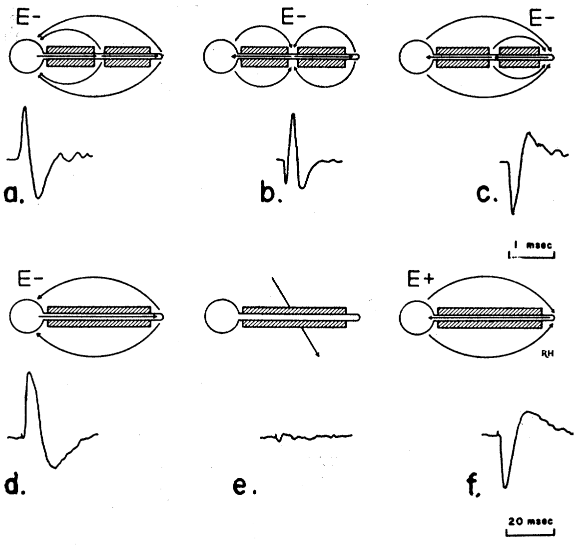

Fig. 1. Patterns of cellular current at the start (*a, d*), middle (*b, e*), and finish (*c, f*) of a propagated spike (*a, b, c*) and of a transient dipole field (*d, e, f*). The tracings represent the potentials that are recorded with a monopolar electrode placed at the somatodendritic end of each neuron (*a, d*), along the mid-portion of each axon (*b, e*), and at each axon tip (*c, f*). *E* indicates the site of the e.m.f.

To test this inference, the determination of the location and properties of the source of the e.m.f. was undertaken. Single-shock, bipolar electrical stimulation of the prepyriform cortex in the rhinencephalon resulted in the formation of a local potential (Fig. 1, *d*), which in a few milliseconds spread over the entire prepyriform cortex without change in its basic form. Simultaneously a mirror image potential (Fig. 1, *f*) spread through the ipsilateral basal nuclei. The nuclear wave was not propagated from the prepyriform cortex, since between the cortex and the nuclei lay an isopotential surface (Fig. 1, *e*). It is thought that this surface is best explained by the assumption that the two mirror image potentials are due to transient activation by the stimulus of a corticonuclear dipole. The e.m.f. of the dipole lies in the cortex, since direct nuclear stimulation did not activate it, and since minor damage to the prepyriform cortex caused concomitant decrease in both potentials, whereas administration of relatively more extensive trauma in the nuclear region had little or no effect on either potential.

The responses of the two potentials to anoxia, topical procaine applied to the prepyriform cortex, and intravenous injection of tubocurarine were identical with those of the first negative peak of the directly evoked neocortical potential (*1*), the second negative peak of which was not found in the paleocortex. This implies that the e.m.f. of the dipole field lies in the dendrites of the prepyriform cortex. During these procedures any change in the form, amplitude, and latency of the cortical potential was invariably accompanied by the same change in the mirror image potential. This means that when a net positive or negative charge is removed from the extracellular fluid in one part of the brain, the same net charge appears in another part. The hypothesis is proposed that in the activated state the prepyriform dendritic membranes produce an e.m.f., which drives current across the membranes into the cell bodies, down the efferent axons (for a distance of 4 to 8 mm), across the axon tips into the basal nuclei, and thence back to the dendrites through the extracellular fluid. This accounts for the negative wave of the dipole (Fig. 1, *d*); the positive wave is thought to be due to a rebound of the e.m.f. in the dendrites, causing current to flow in the opposite direction (Fig. 1, *f*). In some experiments there were three or more reversals in the form of a damped oscillation following a single stimulus.

The "spontaneous" electrical activities of the prepyriform cortex and basal nuclei were found to be mirror images, with the same distribution, gradients, phase shifts, and isopotentials as the prepyriform-evoked potential, and also with the same duration of wave forms. This evidence corroborates the hypothesis (*2*) that the e.m.f. of the electroencephalogram lies in dendritic plexuses, and shows that the electroencephalogram of the prepyriform cortex represents the activity of one pole of an oscillating corticonuclear dipole.

This dipole could be activated by single-shock stimulation of the olfactory bulb, parts of the pyriform lobe, and parts of the thalamus, with latencies (2.5 to 8.0 msec) greater than the latency of the response to direct stimulation (less than 1.0 msec). Propagated spikes preceding the dipole wave were always seen on stimulation of the olfactory bulb and sometimes on stimulation of the pyriform lobe.

It seems clear that a burst of propagated spikes is responsible for transient activation of the dipole in response to single-shock stimulation; "spontaneous" activity might be due to continual trains of spikes reaching the prepyriform cortex along the same paths as spikes evoked by single shocks. Olfactory sensory stimulation evokes spikes in the lateral olfactory tract as well as oscillating potentials in the prepyriform cortex (*3*); pain induces the same oscillating potentials in that cortex (*4*). These findings are interpreted to mean that the e.m.f. of the dipole lies in the prepyriform cortex, but that the "controls" of the e.m.f. lie elsewhere in the rhinencephalon and thalamus.

The pattern of current postulated to occur during formation of the cortico-nuclear dipole is fundamentally similar to that thought to occur during saltatory conduction (*5*) (Fig. 1, *a, b, c*), but with this major difference: during saltatory conduction the site of e.m.f. moves to successive nodes of Ranvier, whereas during field conduction the site of the e.m.f. spreads in directions normal to the direction of conduction. During saltatory conduction in a nerve, the inflow and outflow of axonal current occurs through membrane areas of approximately equal size, but during field conduction the net somatodendritic current appears to pass through the axon tip. Since dendrites have more surface area than axons, the current density at the axonal tip may exceed the density at the dendritic surface. The possibility arises that the periaxonal *current density* may be "amplified" to levels capable of influencing surrounding neurons, in the same way as electrical stimuli delivered to the brain by means of electrodes (*6*). Certain anatomical peculiarities of cortical neurons lend credence to this possibility: the surface projections on the "feathered" dendrite (which would provide a large factor of amplification); myelinated axons purportedly without nodes of Ranvier (which would provide insulated conductors); and free endings (which in this view would not require a chemical transmitter for activation of surrounding cells).

The prepyriform cortex appears to be the site of an electromotive force capable of forming an oscillating current field in the basal forebrain nuclei. The control of the field appears to reside in structures adjacent to the prepyriform cortex. It is suggested that to the extent that rhinencephalically induced currents influence neuronal activity in the basal nuclei, a transfer of information can take place from the cortex to the nuclei without the mediation of propagated spikes (*7*).

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7. This investigation was supported by a fellowship (BF-6317-C) from the National Institutes of Health, U.S. Public Health Service.

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Phenology of Lilac Bloom in Montana

Studies of periodic biological phenomena in relation to the environment, often referred to as phenology, are being made throughout Montana in order to learn more about climate and its relation to agriculture. In the spring of 1956, the Montana Agricultural Experiment Station, in cooperation with the U.S. Weather Bureau and local garden clubs, began a survey of various stages of development of the common purple lilac (*1*). This plant was selected for observation because it is widely grown throughout the state and can be easily identified and because the timing of its various developmental stages appears to be dependent on the "thermal" environment. The "thermal" environment of the plant, as the term is used here, is a physiological concept. Although plant development increases with higher temperatures (within limits), the relation is by no means linear. Furthermore, other factors, such as radiation, wind, humidity, and so on, contribute to the rate of over-all development and to some other physiological responses of the plant. It is this total environmental complex, usually well represented by temperature measurements, which is designated "thermal" environment.

Questionnaire cards were sent to 327 Montana climatological observers by state climatologist R. A. Dightman, requesting information on the following three stages of floral development of the common purple lilac; date of first bloom, peak of full bloom, and final withering of the lilac bloom. The information requested was received from 123 weather observers. In addition, similar data on the lilac and other plants were reported by garden club members, mainly from the larger communities throughout the state.

Some plants that develop through their various stages of maturity without being greatly affected by the natural variations of photoperiod or soil moisture can be used as integrators of the "thermal" environment and thereby can serve as climatic indicators. Hence, indicator plants which are widely distributed and available for observation may be considered "measuring sticks" of *local* climatic differences.

This use of available plant indicators for purposes of learning more about the natural environment can prove to be of particular value to agriculture because local climates often determine success or failure in growing different varieties of agricultural crops.

Since weather observations are made only at widely scattered points, little is known about local climates on individual farms. Also, within similar climatic areas, (so designated on the basis of available weather information), considerable differences in plant development are often found because climatic variables not measured at the climatological stations—variables such as solar radiation, wind, humidity, and the daily course of temperature—are disregarded in the climatic classification. Because of the expense of measuring all important climatic elements and of increasing the density of the climatological network, the phenological approach to understanding regional and local climates may have an important role to play in climatology.

Phenological data are of value not only as climatic indicators; they can be utilized in many other ways. For example, observations on developmental stages of various agricultural crops serve as a basis for scheduling farm operations, even though the agricultural crops observed may not be well adapted as indicator plants. Phenological data can also help in revealing basic information about plant-environmental relationships, since weather effects are often closely linked to their concurrence with particular stages of crop development.

The lilac bloom survey conducted throughout Montana in the spring of 1956 has provided useful information about the climate and plant development in this state. The dates of bloom were plotted on maps, and "late" and "early" areas were determined. Statistical analysis of the information indicates that latitude and elevation were significantly correlated with dates of lilac bloom. It was found that the season was retarded about 1 day for every 20 miles