of 30 April were represented by only three different genera (226 impactions were *Chlorella*). Two explanations for the high density of *Chlorella* exist. Either one to several large clumps of *Chlorella* were impacted and dispersed in the streaking process, or a homogeneous suspension was impacted with minimum dispersion during streaking.

The following information has emerged from our quantitative studies of airborne algae: (i) the algal content of dust can be extremely high (some of our highest counts have revealed no less than 3000 algae per cubic meter); (ii) counts of this nature indicate that algae may exist in sufficient quantity in the air to be a possible cause of inhalant allergy as McElhenney *et al.* (*10*) had previously indicated; (iii) the algal population in blowing dust frequently exceeds that of fungi which formerly have been classified as primary agents for dust allergies; (iv) the algal content (as measured by impaction number) of nondusty air is generally much lower than the fungal or pollen content; however, algae are present at all times except after washout by rain, and so forth; (v) the algal content of air frequently exceeds that of pollen, particularly during seasons when the production is low; (vi) algal diversity does not always accompany an increase in quantity; and (vii) seasonal periodicity in quantity or diversity, has not, as yet, been demonstrated to exist in the Austin area.

R. MALCOLM BROWN, JR.
DONALD A. LARSON
HAROLD C. BOLD
Plant Research Institute and Department of Botany, University of Texas, Austin

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20 December 1963

Lateral Hypothalamic Lesions: Effects on Drinking Elicited by Carbachol in Preoptic Area and Posterior Hypothalamus

Abstract. *Lateral hypothalamic lesions in rats caused a pronounced depression of drinking in response to injections of carbachol into the preoptic area or the posterior hypothalamus. After the lesions were induced, daily free water consumption recovered 70 to 80 percent of that of control animals, but there was little, if any, recovery of drinking induced by carbachol.*

Drinking is elicited in satiated rats by minute injections of cholinergic substances into the hypothalamus (*1*, *2*) and also into diverse portions of the limbic system (*3*). Lateral hypothalamic lesions produce a primary adipsia and aphagia (*4*, *5*), but lesions in most parts of the limbic system have not been reported to have these effects (*6*). This study concerns the effects of lesions in the lateral hypothalamic "feeding-drinking" area on the elicitation of drinking by intracerebral injections of the cholinergic substance, carbachol.

Electrodes were implanted bilaterally and a double-walled cannula (*1*) was implanted unilaterally in the brains of 18 male Sprague-Dawley rats about 100 days old and weighing 300 g. The operation was performed under pentathol anesthesia. In six of the rats the electrodes were aimed at the lateral area of the hypothalamus and the cannula at the preoptic area. In another four, with electrodes aimed at the lateral hypothalamus, the cannula was aimed at the region of the posterior hypothalamus. A third group (four rats) had electrodes aimed at the preoptic area and cannulas at the lateral hypothalamus, and a final group of four had electrodes aimed at the posterior hypothalamus and cannulas at the lateral hypothalamus. Pairs of rats with similar implants were yoked and treated similarly throughout the experiment. One rat of each pair was randomly chosen to receive lesions after baseline data were obtained. Bilateral lesions were made by passing 1.0 ma of anodal direct current for 10 seconds through each implanted electrode with the cathode in the rectum.

After implantation all rats were tested for drinking elicited by two doses of carbachol dissolved in isotonic saline (24×10^{-10} mole and 72×10^{-10} mole in 1 μl of solution) according to the technique of Miller *et al.* (*2*) and with crystalline carbachol (*1*). The experiment was carried out with the injection procedure that produced the most drinking for each pair of animals. The rats with cannulas in the posterior hypothalamus seemed to respond best to the crystals, while the others responded best to one of the two solutions, usually the weaker one.

One mock (insertion of needle or stylus, but no injection) and two carbachol injections per week, spaced at least 2 days apart, were given to all rats for 1 week prior to production of the lesions and for 4 weeks afterward. From the 5th week after production of lesions, one carbachol injection and one mock injection were given per week. Food was removed from the home cages 1 hour before the injection and was not replaced until 1 hour after the injection. Water was always available in inverted graduates with standard drinking nozzles. Carbachol-induced water consumption was measured for 1 hour after injection and normal water intake during the rest of the day. The rats were weighed once each week, and all analyses were based on intake per 100 g of body weight. Carbachol effects were measured by subtracting the water intake during the weekly mock test from the average intake during the weekly carbachol tests.

During the aphagic-adipsic period after the production of lesions, water and wet mash (50 percent ground Purina chow and 50 percent water) were continuously available to the animals with lesions until they started drinking water and eating regular chow. They were maintained by tube feeding of Metrecal until wet mash was accepted. Control rats were maintained on Purina chow and water.

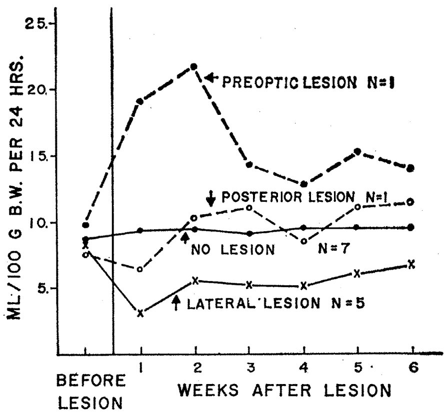

Fig. 1. Mean normal daily water intake of the various groups of animals for 1 week before and each of 6 weeks after production of lesions in experimental animals. The before-lesion measure was not obtained on three of the five pairs of animals with electrodes in the lateral hypothalamus. *B.W.*, body weight.

The first four pairs of rats were run for 16 weeks after the production of lesions in the lateral hypothalamus. After about the 6th week, in two of the control rats there was considerable decline in drinking after carbachol injections (perhaps from clogging of the cannula, infection, or damage by the drug) so that meaningful comparisons were no longer possible. Since both the normal water intake and the carbachol-induced water intake of the four rats with lesions of the lateral hypothalamus did not change after the 6th week, only data for the first 6 weeks are presented in this report, and subsequent rats were tested for only 6 weeks after production of the lesions.

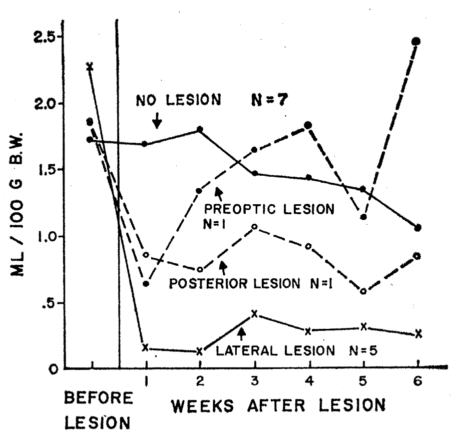

Fig. 2. Mean carbachol-induced water intake of the various groups of animals during hourly testing periods. The measure is expressed as the difference between amounts consumed after carbachol injections and after mock injections. Data plotted for one weekly period before and six weekly periods after the production of lesions. *B.W.*, body weight.

After the experiment, rats were perfused with 10 percent formalin, the brains were removed, sectioned at 50 μ, and stained by the Klüver method or with cresyl violet.

The results of two pairs of rats, one with electrodes in the preoptic area and one with electrodes in the posterior hypothalamus, were discarded because of brain infection and loosening of the electrode fixture, respectively. Microscopic examination of brain sections showed that lesions were approximately 1.0 to 1.5 mm in diameter. The lateral hypothalamic lesions destroyed the dorsal portions of the lateral hypothalamus and often included the ventral part of the zona incerta. Posterior hypothalamic lesions and cannula tips were dorsal to the mammillary bodies and lay between the posterior tip of the lateral hypothalamus and the posterior mammillary nucleus. In the remaining rats, also, lesions and cannula tips were located in the target regions. In no case did a lesion or surrounding gliosis encroach upon the cannula tip.

Since the effects of lesions in the lateral hypothalamus were similar on the rats with cannulas in the preoptic area and those with cannulas in the posterior hypothalamus, the data of the two groups were combined. The lateral hypothalamic lesions produced only a short period of complete adipsia. Four out of five of these rats recovered spontaneous drinking within the 1st week after the production of the lesions. The fifth recovered after 3 weeks. Figure 1 shows that the rats with lateral hypothalamic lesions rapidly reached 70 to 80 percent of control values in their normal daily water intake. The rat with the preoptic lesions showed a large increase in his normal daily water intake; its rectal temperature was elevated, a characteristic of such lesions (7), and the increased drinking was probably secondary to the temperature. The rat with the lesion in the posterior hypothalamus was completely adipsic for 3 days after the lesion, but his daily water intake returned to the level of control rats by the end of the 1st week. The lesion encroached upon the posterior tip of the lateral area of the hypothalamus.

An analysis of variance was done on the data of the rats with lateral hypothalamic lesions and their controls. The control rats drank significantly more water under normal conditions than did the rats with lateral hypothalamic lesions ($p < 0.01$). The control rats showed no significant increase in their drinking over the weeks, while the rats with lateral hypothalamic lesions did increase their drinking significantly (linear trend, $p < 0.05$). The interaction of the linear trends approached significance ($0.05 < p < 0.10$).

Figure 2 shows that all groups drank about the same amount in response to carbachol before the lesions were made. The rat with the preoptic lesion seemed to show a transient decrease in carbachol-induced drinking, but the drinking returned to the level of control rats by the 2nd and 3rd week after production of the lesion. Carbachol-induced drinking was decreased by about 50 percent in the rat with the lesion in the posterior hypothalamus. Perhaps this was a result of the damage to the lateral hypothalamus in this rat. Lateral hypothalamic lesions caused a severe depression of carbachol-induced drinking. Rats with such lesions drank significantly less than their controls ($p < 0.005$), and there was little, if any, tendency for the drinking to increase over time; the linear trend and linear interaction did not approach significance, showing that the fluctuation of a few tenths of a milliliter was well within chance.

If it is assumed that the apparent recovery of normal daily water intake and the permanent depression of carbachol-induced water intake of the rats with lateral hypothalamic lesions are not due to differences in the sensitivity of the measures used, the results suggest that the lateral hypothalamus is an area more essentially involved in the elicitation of drinking in response to central than to peripheral stimuli of dehydration. Perhaps the recovery of the limited ability of rats with lateral hypothalamic lesions to regulate normal daily water intake (5) is due to peripheral stimuli such as dry mouth or general debilitation, while the lack of such recovery in the case of carbachol-induced drinking is due to the absence of such peripheral stimuli. Finally, the important role of the lateral hypothalamus in the elicitation of drinking in response to central cholinergic stimulation is shown by the facts that (i) its function cannot be bypassed by stimulating either anterior or posterior to it, and (ii) lesions anterior or posterior did not produce the large decrements found after lesions in the lateral hypothalamus.

George Wolf
Neal E. Miller
Department of Psychology, Yale University, New Haven, Connecticut

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Infrared Emission Spectra of Organic Solids from 5 to 6.6 Microns

Abstract. *The emission spectra of thin layers of a number of organic solids have been studied from 5 to 6.6 μ in the infrared to determine if there are specific emission characteristics that would allow identification of such solids as organic. This was the case only for very thin films with strong absorption bands.*

Recent successes in unmanned space flight have encouraged speculation that life on Mars might be detected by characteristic spectra in the 5- to 6.6-μ region. This region is selected because the double bonds C=O, C=N, and C=C have strong absorption at this wavelength and they occur in many organic substances. This wavelength is in the sensitivity range of lead selenide infrared detectors at temperatures of liquid nitrogen. Lead selenide has high sensitivity in this region at temperatures of liquid nitrogen. Characteristic emissions or absorptions at longer wavelengths could be detected only by detectors at much lower temperatures. At present such temperatures are unattainable on space-craft. At shorter wavelengths reflected solar radiation would obscure emission from the planet so that only reflection spectra such as those shown by Sinton (*1*) would be detectable.

To test the feasibility of observing characteristic emission spectra from 5 to 6.6 μ, experiments were made with a grating spectrometer in a vacuum chamber, a black body, and a means of heating the specimen. A spectrometer, 0.5 m Fastie-Ebert (*2*), with a grating 10 × 10 cm was used. The detector was lead selenide cooled to about 77°K by a miniature Joule-Thompson cryostat. The vacuum chamber was evacuated to eliminate water vapor and a flow of dry nitrogen was begun to the cryostat. The expansion of the nitrogen in the cryostat produced the liquid nitrogen to cool the detector. The gas exhausted from the cryostat produced an equilibrium pressure of 2 mm-Hg in the vacuum chamber. Specimens were placed in a separate chamber equipped with a valving arrangement to allow specimens to be changed without altering the pressure and temperature conditions in the main chamber. The two chambers were separated by a calcium fluoride window.

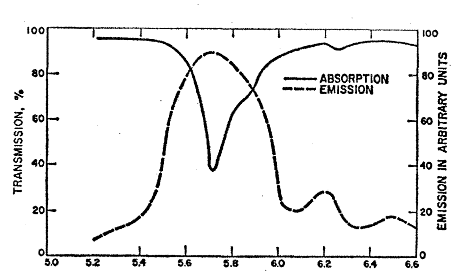
Absorption measurements were made with a black body at a temperature of 100°C as a source of infrared radiation with the specimen at room temperatures. Measurements of emission spectra were made with the sample in contact with an aluminum plate at 100°C. None of the specimens had a change in their absorption spectrum after heating.

Thin plastic films were examined first because many of them have strong absorption bands that are attributed to the double bonds. These films are mechanically stable, homogeneous, and can be acquired in a number of thicknesses. Mylar, at a thickness of 120 μ, had strong absorption bands, but was virtually without a characteristic emission and showed only an enhanced emission over that of the aluminum plate. A film of Mylar 6 μ in thickness was examined next. The absorption was pronounced although not as intense as in the thicker specimen. The emission spectrum contains a strong emission peak corresponding to the absorption feature as shown in Fig. 1.

A thin film of Teflon was placed on a polyethylene film and the same measurement was made. Polyethylene, in thin films, has virtually no absorption or emission at 5 to 6 μ and served merely as a mechanical support for the Teflon which was of the same order of thickness as the 6 μ Mylar. The strong absorption feature and a corresponding emission feature are shown in Fig. 2.

Dupont film H, a plastic similar to Mylar, was examined a 50 μ. Its pronounced absorption bands and emission spectrum are shown in Fig. 3. The emission features were far less prominent than those seen with thinner films.

As a result of the experience with plastic films, the method was next applied to organic matter. A thin film of *Bacillus subtilis*, approximately 12 μ thick, was placed on a calcium fluoride substrate and examined after it had been dried in a vacuum. Upon examination, there were neither absorption features nor emission characteristics.



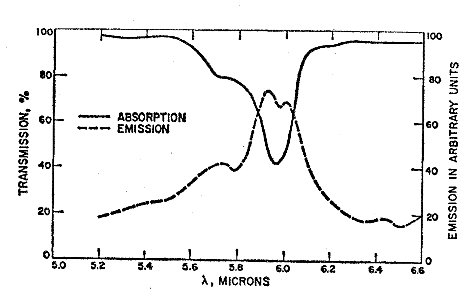
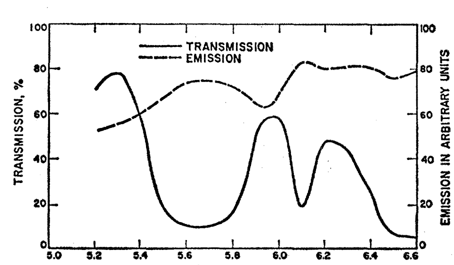


Fig. 1 (left). Emission and absorption of 6 μ Mylar. Fig. 2 (right). Emission and absorption of 6 μ Teflon.



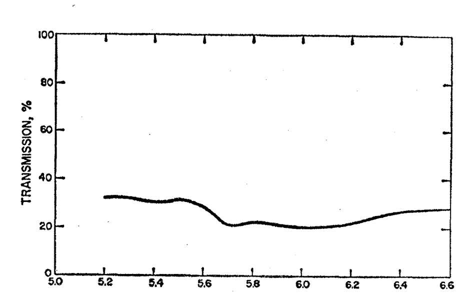


Fig. 3 (left). Emission and absorption of 50 μ film H. Fig. 4 (right). Emission of cactus epidermis.