that much of the input is integrated in such a way as to determine the probability of firing by certain limited sources or temporal patterns of impulses. Furthermore, the ratio of input to output impulses is probably very high and therefore insensitive to considerable fluctuations in absolute numbers of input impulses of the most active pathways.

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Thermal Decomposition of Rare Earth Fluoride Hydrates

Abstract. A thermogravimetric study of the thermal decomposition of La, Nd, Sm, Gd, Dy, Er, and Y fluoride hydrates shows that minimum dehydration temperatures are from 315° to 405°C; conversion of the fluorides to oxyfluorides begins in the 600° to 690°C temperature range.

As part of our investigations of the thermal decomposition of rare earth compounds (*1*), the pyrolysis of the rare earth fluoride hydrates was studied. The dehydration of these compounds is of interest at the present time because the anhydrous fluorides are used to prepare the rare earth metals.

Popov and Knudsen (*2*) previously studied the isothermal decomposition of the anhydrous rare earth fluorides and found that the pyrolysis took place in two steps. The first step was the conversion to the metal oxyfluoride; this was followed by the second step, the conversion of the oxyfluoride to the metal oxide. To our knowledge, the dehydration of the hydrated metal fluorides has not been described, and it is the subject of this report.

The rare earth fluorides were prepared by precipitation of the metal ions with aqueous hydrogen fluoride. The precipitated metal fluorides were filtered off through filter paper, washed with water, and air-dried for 24 hours at room temperature. Under these conditions, the metal fluorides corresponded approximately to the ½- or 1- forms of the hydrates.

An automatic recording thermobalance, previously described (*3*), was used to obtain the thermolysis curves. The samples ranged in weight from 90 to 100 mg and were run in duplicate or triplicate. A furnace heating rate of 5.4°C per minute was employed.

The thermograms of the rare earth fluoride hydrates are given in Fig. 1. From these curves and from previous studies (*2*), the following general pyrolysis pattern is presumed to take place:

$$MF_3 \cdot (\tfrac{1}{2} \text{ or } 1)H_2O \rightarrow MF_3 \rightarrow MOF$$

All of the compounds began to evolve water of hydration in the 40° to 60°C temperature range. However, horizontal weight levels corresponding to those of the anhydrous metal fluorides were obtained only for neodymium, samarium, and gadolinium. All of the other metal fluorides lost weight continuously throughout the entire thermogram.

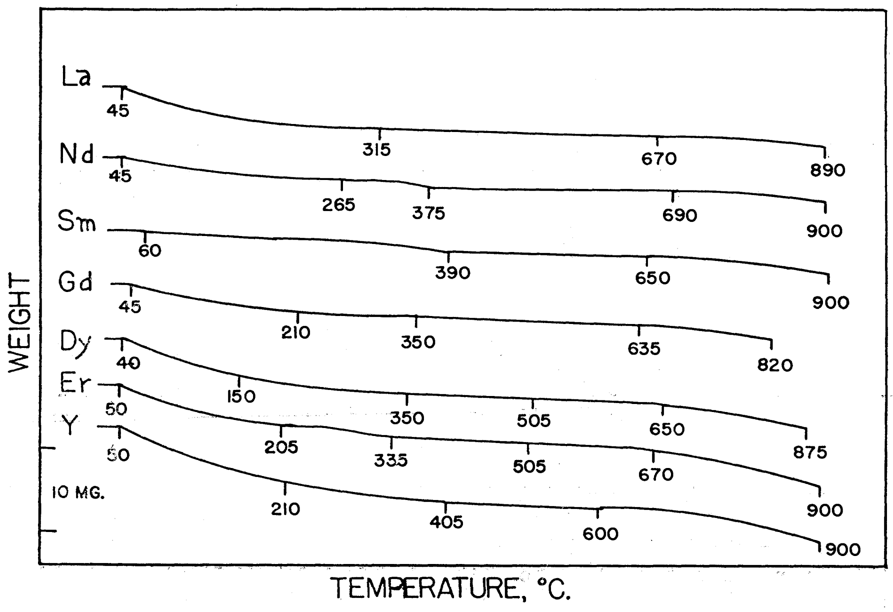

Fig. 1. Thermograms of the rare earth fluoride hydrates.

The pyrolysis of the metal fluorides to the oxyfluorides began in the 600° to 690°C temperature range. The rates of pyrolysis were quite slow and did not result in the metal oxyfluoride weight levels even at 900°C. Since the upper limit of the thermobalance furnace is 900°C, the pyrolysis could not be extended to higher temperatures.

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Transient Memory in Albino Rats

Abstract. Rats were trained on the repeated reversal of a position habit in a T-maze. Test trials of memory were given at varying intervals after the completion of each reversal. Those animals exhibiting a consistent preference for one side failed to retain the effects of training to the nonpreferred side for more than a few minutes.

Boycott and Young (*1*) have demonstrated the possible existence of reverberatory circuits mediating a discrimination habit in brain-damaged octopuses. The animals were preoperatively trained to attack a crab but to withhold the attacking response when the crab was presented along with a white card. If a response was made to the latter condition, the octopus was punished with an electric shock. Damage to certain parts of the brain eliminated the habit. The octopus attacked the crab under both conditions when trials were spaced by 2 or more hours. If, however, one negative trial (white card presentation) succeeded another within 5 minutes, the animal, correctly, withheld the response. Apparently the preceding negative trial had set up some short-term activity within a neural system corresponding to a memory trace of that trial which accounted for the absence of a response to the crab a few minutes later. The subsidence of this neural activity would explain the reappearance of the attacking response after an interval of 2 hours.

The present experiment reveals a similar transient memory in albino rats, but under a different set of conditions. Normal rats and rats subjected to either cortical or subcortical damage were trained on a simple water T-maze. Prior

Table 1. Mean errors to criterion and total number of correct responses on test trials for each position.

Rat No.	Principal damage	Preferred				Nonpreferred			
		Learning	1 min	1 hr	5 hr	Learning	1 min	1 hr	5 hr
18*	Subrhinal cortex	2.0	6	6	6	7.5	4	0	1
26*	Tegmentum	0.3	6	6	6	4.6	3	0	0
25*	Superior colliculus	0	6	6	6	5.0	4	0	0
23*	Posterior cortex	1.0	6	6	6	6.3	4	2	0
27*	Subrhinal cortex	0.3	6	6	6	4.8	4	2	0
2*	Anterior cortex	0.6	6	6	6	2.0	5	2	0
6	Subrhinal cortex	2.5	5	5	4	2.5	6	5	5
9	Hippocampus	3.6	5	5	5	6.5	4	6	4
10	Amygdala	1.0	6	6	6	4.3	5	6	6
20	Caudate	1.3	5	6	6	1.6	6	5	5
33	Posterior cortex	2.6	6	6	4	3.5	5	5	6
1*	None	0.3	5	6	6	2.7	4	0	0
5*	None	0	6	6	6	1.5	6	0	0
34	None	0.3	6	6	5	1.0	6	6	6
35	None	0.5	6	4	5	0.5	6	5	5
36	None	0.5	6	6	5	0.5	5	5	5

* The animal showed a statistically significant preference for one side.

to this experiment, all animals were given considerable experience in the maze. For 12 days, each rat was trained to go to the arm of the T that was incorrect on the immediately preceding day. A ladder was provided at the end of the correct alley which allowed the animal to climb onto a drying platform. If an error was made, the animal had to swim back to the choice-point and choose the other arm of the T. Training to the correct side was continued until the animal reached the criterion of three errorless responses within a series of four trials. During training, the intertrial interval was 30 seconds. Each day the animal was given one test trial 1 minute, 1 hour, and 5 hours, respectively, after it met the criterion. During these three daily test trials of memory, the ladder was placed in the arm which was correct for that particular day.

Table 1 presents the individual mean error scores in learning to go to the preferred and to the nonpreferred positions (*2*). Also included for each animal is the total number of correct responses made on the test trials at each interval, the maximum being six correct responses for each position. Transient memory is clearly revealed in those rats which were performing under a strong position habit: those which made significantly more errors learning to go to one side (that is, left) than to the other (that is, right).

It can be seen that when training was to the nonpreferred side, the animal retained the effects of training for 1 minute, but not after 1 or 5 hours. Among the eight animals which showed a significant preference, performance on the 1- and 5-hour test trials was very reliably higher when the preferred side was correct than when it was incorrect. No such differences were apparent for the animals not operating under a significant position habit. Of the 11 operated animals, six revealed the phenomenon of transient memory. Additional animals have since been run, and it has been found that approximately 50 percent of all the operated animals display a strong position habit; of these, all showed transient memory of the effects of training to the nonpreferred side. Normal rats also reveal position habits, but the frequency of strong position habits is considerably smaller. Table 1 shows data for two such normal rats (No. 1 and No. 5) which exhibited poor memory of training to the nonpreferred position. These transient memories obviously are not a function of surgical brain damage.

This phenomenon strongly supports the view that the neutral memory trace passes through an initial reverberatory state followed by a more permanent structural state. In this experiment, massed training to the nonpreferred side apparently initiates activity within a neural system which inhibits the response to the preferred side. This activity, at the same time, produces a structural trace having the effect of strengthening the response tendency to the nonpreferred side. The activity of the system, however, subsides within a few minutes, leaving only the newly formed structural trace. Since a strong preference previously existed for the opposite side, the strength of the new trace is not as great as that corresponding to the preferred side. Thus, a test trial given 1 hour after training would result in a response to the preferred position. If, however, the test-trial is given a few minutes after training, the neural system is still active and permits a response to the nonpreferred position. In those animals not exhibiting a strong position habit, a similar sequence of events occurs. But the reason that the animals respond successfully 1 hour after training is that the structural trace left by the previously active system is of greater strength than that corresponding to the other side.

That this interpretation seems to be the correct one is indicated by two lines of evidence. First, a position habit can be eliminated by special training to the nonpreferred side. This was done for those animals exhibiting a position habit (see Table 1). All animals except one (animal 18), were subsequently able to perform significantly better on the 1- and 5-hour memory tests after training to the formerly nonpreferred position. In the second place, with a more stringent criterion of learning (six errorless responses within a series of seven trials), performance on the 1-hour test trials significantly increased, although the position habit in some cases still existed.

To what extent a similarity exists between these data and those of Boycott and Young is difficult to say. Boycott and Young concluded that brain damage to the vertical and frontal lobes somehow seriously affected the permanent memory system of the octopus. Our results suggest the interpretation that damage to these areas may have intensified the attacking tendency of the octopus, possibly by releasing an inhibitory mechanism. Thus, the octopuses would more readily attack the food and behave like rats that have a strong position habit.

In any event, the data of this experiment demonstrate that habit tendencies acquired by massed practice can be maintained by temporary active neural systems, probably reverberatory circuits, and that the amnesic effect of discrete subcortical stimulation may be due to the disruption of this activity (*3*).

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18 August 1958