Table 1. Description of training for nine form reversals.

Training stages	Area of positive form (cm^2)	Area of negative form (cm^2)	Size-difference ratio larger : smaller	Trials (No.)
1	41.80	280.49	6.70:1	10
2	42.72	224.76	5.26:1	10
3	42.72	180.19	4.21:1	10
4	52.94	180.19	3.40:1	10
5	52.94	173.69	3.28:1	10
6	66.87	173.69	2.59:1	10
7	66.87	156.04	2.33:1	10
8	78.02	156.04	2.00:1	10
9	78.02	136.53	1.74:1	10
10	85.50	136.53	1.59:1	30
11	85.50	121.67	1.42:1	20
12	95.67	121.67	1.27:1	20
13	95.67	114.24	1.19:1	20
14	101.24	114.24	1.12:1	10
15	101.24	110.53	1.09:1	10
16	104.95	110.53	1.05:1	10
17	107.74	107.74	1.00:1	30

both animals ($P < .01$, binomial) for the previously positive form. Thus, during the early training stages, when the size differences were large, attention was focused on this dimension and the animals learned little about changing their form preference. This interpretation is consistent with evidence indicating that animals frequently solve a problem on the basis of one relevant cue while learning little about a second relevant cue (*9*).

Probe-trial choices during the next 40 to 80 training trials, when size differences had been reduced considerably, demonstrated no significant preference for either of the two forms. The curves in Fig. 2, however, show a steady increase in responses to the previously negative form. This means that as the size discrimination became progressively more difficult, the animals, on any given trial, attended to both size and form cues with attention gradually shifting more and more to the form cue. It is likely that during this phase of progressive training the sea lions learned to change their form preference. Finally, when the size difference ratio had decreased to 1.27 : 1, a value considerably above *Zalophus*' threshold (*7*), the preference for the previously negative form approached a probability value of 1.00. This preference persisted even when the size cue was no longer available.

The present results support the notion (*2*) that, during repeated errorless reversals of a form discrimination, attention is primarily focused on the original dimension (size) during the early stages of each training series and then is gradually shifted to the superimposed second dimension (form) as a function of the increasing difficulty of the original discrimination.

Such an interpretation is consistent with Mackintosh's (*3*) recent position on the issue of attention in animal discrimination learning, which he describes as a "modified noncontinuity theory." This position states that although animals do not attend to all cues equally, they may attend to more than one cue on any given trial, depending on such factors as the difficulty of the original discrimination, the abruptness with which a second dimension is introduced, and the degree to which the original discrimination is learned. The first two variables are positively related to shifts of attention; the relationship of the third variable, however, is negative. Since both sea lions had extensive size discrimination training, the present results indicate that difficulty of the original discrimination is a more potent fatcor in attention shift than is degree of original training.

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8. Despite the fact that the first ten trials of each day began with a repetition of the form discrimination which had terminated testing on the previous day, Sam made seven errors before training for the ninth reversal was begun, and Growler made nine errors before training for the seventh reversal was begun. In order to be sure that the probe-trial data would not be severely affected by this phenomenon, both animals received a repetition of training on the previous reversal before starting on the next reversal. Neither animal made an error during this repetition of training. This finding suggests that even though errorless learning of a series of reversals remains quite stable from day to day during the early reversals, an increasing number of reversals leads to relatively strong recovery of previously trained form preferences.
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Maternal Behavior in the Domestic Cock under the Influence of Alcohol

Abstract. *When normal male domestic chickens were given a single dose of grain alcohol and then exposed to newly hatched chicks, they assumed maternal behavior. The same behavior can be elicited by the administration of prolactin, but the results of these experiments suggest that maternal behavior in the cock is not exclusively dependent on hormonal mechanisms.*

Maternal behavior can be induced in domestic cocks by repeated injections of prolactin (*1*). This finding is in agreement with the general observation in a variety of species that the development of maternal behavior is associated with secretion of prolactin (*2*). However, we induced maternal behavior in cocks by administering a single dose of grain alcohol and then exposing them to newly hatched chicks. Maternal behavior is not part of the normal behavior cycle of male domestic chickens and our procedure for inducing it precludes the operation of hormonal mechanisms (*3*).

In a pilot study we exposed individually seven mature, sexually active cocks

Table 1. Avoidance-aggressive and maternal behavior of the control and alcohol-treated cocks and approach behavior of the chicks. There were five cocks in each group.

Behavior	Controls (No.)					Alcohol treated cocks (No.)				
	Day					Day				
	1	2	3	4	5	1	2	3	4	5
Killing chicks	0	0	0	3	1	0	0	0	0	0
Allowing chicks to die of exposure	0	0	2	3	5	0	0	0	0	0
Stamping on and pecking at chicks	3	4	3	4	4	0	0	1	1	1
Avoiding chicks	5	5	5	5	5	0	0	1	2	2
Sheltering chicks during night	0	0	0	0	0	5	4	3	3	3
Sheltering chicks during day	0	0	0	0	0	4	4	3	3	3
Defending chicks	0	0	0	0	0	0	0	1	2	2
Clucking	0	0	0	0	0	0	0	0	1	2
Approached by chicks during terminal test					0					3

to groups of newly hatched chicks, first when the cocks had not been given alcohol, then 3 weeks later when they had been given alcohol (Fig. 1). None of the cocks had developed maternal behavior during the first session when they were not under the influence of alcohol. The observation was terminated at the end of the third day because the chicks died of exposure. On the other hand, all but one cock sheltered the chicks during the first night of the second session when they were under the influence of alcohol. Subsequently four cocks developed maternal behavior and two cocks gradually returned to the original avoidance and aggressive behavior patterns.

Ten white Leghorn cocks, all 9 months old, were used in the experiment that was prompted by these pilot observations. This experiment was run in heated rooms under a constant temperature of 80°F. There were no elevated structures in the rooms. Five cocks received alcohol (9 ml/kg body weight, of 33 percent grain alcohol administered orally) and five cocks received an equal amount of water without alcohol 30 minutes before the initial exposure to newly hatched chicks. Each cock was presented with a group of six White Rock chicks less than 24 hours old. The cock was caught, put on the ground on its back, and its beak was held in a vertical position. This treatment immobilizes the bird as long as the beak is held and results in an immobile, drowsy state which can continue even after the beak is released, as long as the bird does not move its head. The chicks were placed between the wings and body of the cock and the cock was kept immobile for 30 minutes. All chicks responded to the body warmth of the cock by rubbing against its feathers and emitting pleasure calls. At the end of 30 minutes, the experimenter carefully released the cock's beak and moved out of the room. Within 0 to 10 minutes the cock turned on its feet and began to walk around. Some minor motor coordination disturbances were seen in the alcohol-treated cocks. However, it did not prevent them from moving around freely in the room, and it disappeared by the following morning. We observed the behavior of each cock twice for 30 minutes every day and once for 15 minutes every night for 5 days, and recorded the various behavior patterns as in the pilot study. In addition, we tested the behavior of chicks at the end of 5 days by collecting them and releasing them individually in the presence of the cock and observing whether they approached the cock upon release. We also recorded the characteristic behavior patterns of the cocks and chicks on motion picture film.

This experiment yielded essentially the same results as our pilot study (Table 1). All of the alcohol-treated cocks sheltered the chicks during the first night. As a result, none of their chicks died of exposure. Three of the alcohol-treated cocks maintained the sheltering behavior and developed additional attributes of maternal behavior, while two gradually returned to avoidance and aggressive behavior. Only the alcohol-treated and maternally behaving cocks were followed consistently by their chicks and only they were approached by the chicks during the final test. By contrast, the controls showed avoidance and aggressive behavior only. They allowed the chicks to die of exposure and three controls actively killed their chicks.

These observations confirm the possibility of inducing maternal behavior in domestic cocks by alcohol. The results also suggest that maternal behavior in the cock is not directly dependent on hormonal mechanisms since alcohol is not identified as a prolactin releaser or as an inhibitor of androgen (*4*). Whatever the direct role of prolactin may be in the development of maternal behavior, it is possible that it is related to a temporary depression

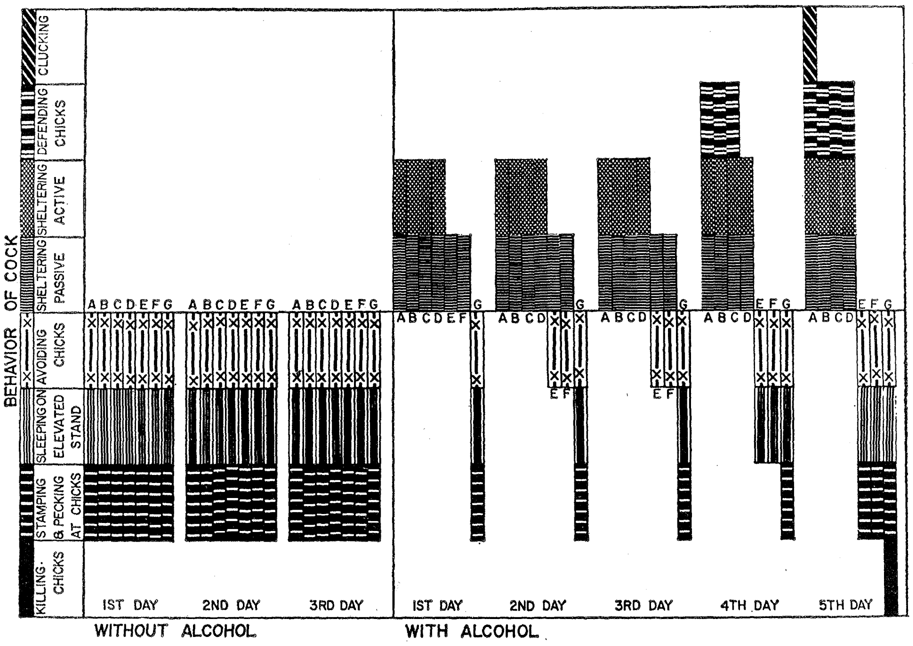

Fig. 1. Response of the cocks to the chicks before and after the alcohol treatment in the pilot study. *A*, *B*, *C*, *D*, *E*, *F*, and *G* refer to individual cocks. *A* and *B* are Leghorn hybrids, the remaining are White Leghorns. The bars indicate the presence of behavior patterns spelled out on the ordinate. They are arranged in order of increasing intensity of avoidance-aggressive and maternal behavior, but at the separate levels they should be viewed as qualitative yes-no indicators rather than as quantitative summations.

of avoidance and aggressive responses. Our observations show that once the initial avoidance and aggressive behavior is depressed by alcohol, and the cock experiences direct bodily contact with the chicks during this period, maternal behavior may develop. Such experience does not result immediately in fully developed maternal behavior, but it serves as an essential starting point for its gradual development. There were no noticeable developmental changes in the avoidance and aggressive behavior of the controls. The appearance of active killing of the chicks on the fourth day was not associated with a general increase in frequency or intensity of previous aggressive behavior; it appeared to be elicited by the general sluggishness of the overexposed chicks and by their consequent inability to escape from the cocks. On the other hand, there was a definite developmental trend in all alcohol-treated cocks, except the one in the pilot study which did not shelter the chicks during the first night; either they gradually began to avoid the chicks and became more aggressive towards them, or their maternal behavior became more pronounced.

The development of alcohol-induced maternal behavior appears to be dependent on: (i) the critical state of the central nervous system brought about by the administration of alcohol; (ii) a primary contact with the newly hatched chicks during this state; and (iii) continued social interaction with the chicks. This process may contain important similarities with imprinting-like learning processes in birds.

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3. We were led to the investigation of this phenomenon by an old custom, prevalent among Hungarian farmers, of transferring newly hatched chicks from the hen to a "drunken cock." The farmers justify this transfer by the argument that: (i) the cock is better than the hen at defending the chicks from predators; and (ii) such transfer frees the hen for returning to the commercially desirable egg-laying cycle.
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Tektites are Terrestrial?

Faul (*1*) recently tried to show, on the basis of the chronology of tektites, that the old problem of their origin was definitely resolved (terrestrial). More-thorough examination shows there is nothing in it, and that it is only a matter of a collection—to tell the truth, very exceptional—of chance circumstances.

The K:Ar chronology has shown that the moldavites were contemporary (14.8 to about 1 million years) with the glasses of the Nördlinger Ries (*2*), but they are chemically different, as shown by Chao (*3*) and by Schnetzler and Pinson (*4*). Likewise the ivorites and the glasses of Bosumtwi Crater may be contemporary (1.3 million years), but they also are chemically different. Terrestrial glasses (volcanic or impact) always contain much more Fe_2O_3, less MgO, and much more water than do tektites. But, exceptionally, the glasses of the Ries have the mean composition of tektites, while the moldavites have an abnormal composition, containing more SiO_2 and less Al_2O_3, FeO, Fe_2O_3, MgO, and Na_2O; their color, green, also is different.

But the moldavites are 300 to 400 km from the Ries and the ivorites are 300 km from Bosumtwi, while volcanic or impact ejecta do not exceed 10 km. Exceptionally, a limestone block was projected 65 km from the Ries; a further projection of debris is conceivable only for Moon. The aerodynamic work of Adams (*5*) has established that tektites could not have traversed the atmosphere, beginning from the ground. Geological work, particularly that of Heide and the eminent and lamented Bucher (*6*), has established that the Ries and the Bosumtwi craters have an endogenous explosive origin and that coesite was not proof of impact. No crater can be associated with the American and the Pacific tektites, the latter being dispersed from China to Tasmania. The moldavites and the ivorites are therefore absolutely independent of the Ries or of Bosumtwi. The constant of proportion $Sr^{87} : Sr^{86}$ (*7*) establishes their common origin.

The K:A datings of terrestrial rocks and of tektites are very certain, likewise the U:Pb and Rb:Sr datings of terrestrial rocks, but the U:Pb and Rb:Sr datings of tektites are not sure. Chemical and isotopic analyses, as well as aerodynamic work, have shown that tektites have been raised, before their fall, to temperatures exceeding 2550°C (*3, 4*), and that they have lost a notable fraction of their volatile constituents: alkaline, earth-alkaline, Pb, and such. Fast meteors show the color of stars F5, which corresponds to a temperature of 7000°K. It is thus that tektites could show all the U:Pb and Rb:Sr ages possible—between 10 and 2000 million years. These "ages" have no physical significance, and it is again by a chance effect that the "ages" coincide with those of the rocks of the Ries (300 million years) and of Bosumtwi (2000 million years).

Discussion of the problem of tektites should not therefore be confined to the sole consideration of their apparent chronology. A great deal of work has, on the contrary, demonstrated incontestably their cosmic origin. One of us has shown (*8*) how easy it is to conceive of the rapid transport of a block of obsidian (containing a little peridot and traces of nickel-iron, and coming from the debris of the original Olbers planet) from the asteroid rings to Earth, with a comet of the Jupiter family as intermediary; the fragmentation of the nucleus at perihelion; and the distribution by ablation of the tektites over a great stretch of the Pacific (Indochina, Indonesia, and Australia).

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