sibility of previous contact between any of them is negligible. Captured animals were housed singly in the laboratory for 1 to 5 days before being tested. Each group was composed of four animals. We used a large observation cage (2.4 by 1.2 by 1.2 m) with a glass front. The floor was covered with soil, and grass was planted in the cage to simulate natural habitat. Rocks and logs were included for cover, and food and water were available at all times. Social interactions were recorded during the 30-minute period immediately after the introduction of each group into the cage (trial 1). There was another 30-minute observation period (trial 2) 24 hours after the first. Introductions into the large cage occurred at approximately 9 p.m., and observations were made under illumination from two 20-watt red light bulbs. The sex composition of the organized and disorganized groups (Table 1) was not equated more exactly because some difficulty was encountered in obtaining groups of four adults from areas small enough to insure previous contact between the individuals. To minimize the amount of time during which captured animals were kept singly, we began the tests as soon as four adults were secured from a given area. However, three of the organized groups have identical disorganized counterparts, and a comparison of these groups gives the same results as an overall comparison. Agonistic encounters are grouped as major (fights and chases) or minor (threats and avoidance behavior by subordinate animals).

In trial 1, the disorganized groups showed significantly more total encounters ($P > .98$) and major encounters ($P > .99$) than the organized groups did (Table 1). In trial 2, there was no significant difference in number of agonistic encounters. The organized groups showed no significant decrease in number of encounters in trial 2. The disorganized groups exhibited a significant decrease, in both total ($P > .99$) and major encounters ($P > .99$).

The higher agonistic interaction rate noted in the groups of animals which had had no previous contact must be attributed directly to social disorganization. Other factors such as confinement and laboratory conditions were equal and apparently much less important. This difference in the behavior of the organized and disorganized groups indicates a familiarity between individuals trapped from the same area and strongly suggests that some social organization existed in the natural populations from which they were taken.

Table 1. Comparison of agonistic encounters in organized and disorganized cotton rat populations. Disorganized groups: I, four males; II, three males and one female; III, three males and one female; IV, four males; V, three males and one female; VI, three males and one female. Organized groups: I, three males and one female; II and III, four males each; IV, two males and two females.

Groups	Major encounters		Total encounters	
	Trial 1	Trial 2	Trial 1	Trial 2
	Disorganized			
I	30	11	6	1
II	23	7	7	2
III	15	4	6	1
IV	31	5	11	0
V	13	9	2	0
VI	33	4	12	0
	Organized			
I	5	6	0	0
II	11	5	0	1
III	9	5	2	1
IV	12	7	0	0

The rapid decrease in agonistic behavior during the first 24 hours in the disorganized groups indicates that dominance relationships are established rapidly. Thus, it seems that social disorganization in this species does not persist long and may be a factor in studies on social behavior only for a short initial period.

Intense exploratory behavior immediately after introduction of the animals into the cage undoubtedly was a factor in the higher number of interactions during trial 1. If the apparent (although not statistically significant) trend toward fewer encounters on trial 2 in the organized groups is real, this probably accounts for it.

Our observations, along with trapping results which indicate extensive overlap of home areas, suggest that the social behavior of the species in nature is characterized by relative dominance (*6*).

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Reversal Learning and Forgetting

Gonzalez, Behrend, and Bitterman (*1*) assert, on the basis of their experimental findings, that improvements in reversal learning occur as the result of increasing decrements in retention. In their report, however, they fail to include some data vital in the testing of their hypothesis. When such data are provided (see, for example, *2*, *3*) the hypothesis is invalidated.

If we accept the claim of Gonzalez *et al.* that decrements in retention account for improved reversal learning, it is logically impossible for the error curve to fall below the initial error level (on reversal 0), unless initial performance of the group is above chance —a situation not ideally suited for studying reversal learning. That is, if progressive improvement in reversal occurs because the pigeon remembers progressively less about the reward contingency of the previous session, then, after a large number of sessions, the pigeon is effectively naive when confronted with the discrimination task. Therefore, the lowest error score the pigeon could attain on a reversal problem would be no better than in its very first session (reversal 0). Data on error scores in the first session, which the authors do not present, are needed to determine the validity of their hypothesis.

Such data are provided in an experiment of Gonzalez, Roberts and Bitterman (*2*). Using a simultaneous black-white discrimination, they find that their rats make a median number of 16 errors in reversal 0. In subsequent reversals the error score rises at first and then declines to a stable level of eight errors per reversal. Since, for the rat, performance after a large number of reversals is superior to that at reversal 0, it is clear that there *is* retention of information concerning earlier sessions. Further, since, according to Bitterman (*3*, p. 404), "in experiments on habit reversal . . . the pigeon behaves like the rat," we would predict that if the data for reversal 0 were provided (and perhaps the number of reversals increased) the above results would also hold true for the pigeon. Thus, the data for the rat, and no doubt for the pigeon, render highly questionable the hypothesis of Gonzalez, Behrend, and Bitterman that improvement in reversal learning is a result of decreased retention.

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An animal trained in a choice situation learns not only which alternative is rewarded, but other things as well. To say that after a series of reversals it is unable to remember at the beginning of any session which alternative was rewarded in the preceding session is not to say that it is "effectively naive," because there is no reason to believe that adjustment to the unvarying features of the training situation is impaired progressively by reversal. In one of the papers cited by Wiener and Huppert, I have emphasized the need to distinguish between the general effects of practice (known since the turn of the century) which may contribute to improvement of performance in reversal experiments and the effects which may be specific to reversal training (*1*, pp. 407–409). Simply to compare performance in reversal 0 (the original problem) with performance in some later reversal is to confound these effects. The value of the 2-day design is that nonspecific factors may be controlled by comparing reversal and nonreversal performance at various stages of training (*2*).

Perhaps it will be helpful to look at the pigeon data in a somewhat different way. One of the curves plotted in Fig. 1 shows the probability of error on the first ten trials of reversal 0. (There were 80 trials on each problem, 40 per day, with positive and negative colors reversed every 2 days.) The animals began with a slightly greater-than-chance tendency to choose the unrewarded color, but a preference for the rewarded color was established quickly, and the new preference was retained until the following day (the first nonreversal day), as shown by the low probability of error on the early trials of that day (curve NR-1). There was good retention also on the 3rd day of the experiment (the first reversal day), as shown by the high probability of error on the early trials of that day (curve R-1). After 120 such problems, however, retention from day to day was rather poor (*3*). Both the reversal (R-120) and the nonreversal (NR-120) curves begin at about the chance level, and they fall at much the same rate in subsequent trials. Reversal performance improves progressively over a series of reversals, but nonreversal performance deteriorates. The convergence may be traced to forgetting, which is measured directly in such an experiment.

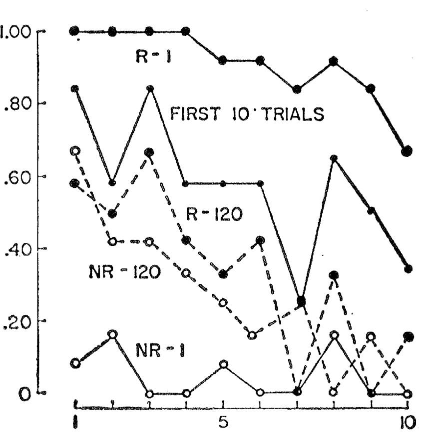

Fig. 1. Probability of error per trial plotted for the first ten trials of selected days (R, reversal; NR, nonreversal).

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3. The training of the animals was carried beyond the point described in the original report by Miss Alice Schade, who provided the later data.
4. Supported by contract Nonr 2829(01) with ONR.

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Stone Tools and Woodworking

Comparatively recent experiments in the manufacture of wooden implements with flint tools have shown results rather similar to those in (*1*).

Breasted (*2*) reported that with a set of stone axes a Danish woodsman was able in 10 working hours to fell 26 pine trees 20 cm in diameter and hew them into logs. The entire work of hewing the planks and timbers and building a house was then done by the same man in 81 days.

The archeologists Troel Smith (*3*) and Jorgensen, together with two professional lumberjacks, using several hafted axes fitted with authentic Stone Age blades, found that the usual technique of chopping trees (as with steel axes) shattered the edges of the delicate flint blades and broke some of them in two. They soon discovered that, by chipping away at the tree with short quick strokes using mainly wrist and elbow, even with unresharpened blades from antiquity they could fell oak trees larger than 30 cm in diameter in 30 minutes.

Pont (*4*) states that with a good, grooved, ground ax, hafted and ready for use, he felled a 7.5-cm-diameter tree in 10 minutes. It took only 4.5 hours to make the ax, while a good arrowhead with serrated edge required only 1.5 minutes.

The speed with which flints have been made for flintlock pistols is quite extraordinary. Clarke reports (*5*) that, in England, as recently as 1868, men were able to prepare 300 flints an hour or 5000 to 7000 a day! Some men tallied 200,000 in a single week. He says that the accumulation of debris within 200 years was "almost beyond belief."

In view of the further discovery (*1*) relating to fragments and broken tools due to faulty handling, it seems not unlikely, as Lowie (*6*) proposed, that some supposed eoliths may well be nothing more than rejects or waste rather than evidence of poor skill in manufacture. Indeed, Breuil (*7*) found that weather conditions could significantly affect the end product—one individual might produce very different types of tools on different days; on one very cold day his co-worker, trying to make an Acheulian hand ax, ended up with a large Clactonian flake! Interpretation of the true significance of a flint tool or weapon can be difficult at times.

Years ago Dawson (*8*) noted that certain hollow-ground gouging chisels found in Europe were presumed to have been used for hollowing canoes. But he observed that the same basic tools were very commonly found among North American Indians who used birch-bark canoes clearly not requiring such tools for manufacture. The use to which the Indians put the tools was quite different: to tap maple trees! Dawson suggested that the use may have been the same in Europe.

Some very special kinds of arrowheads first appeared to be examples of poor craftsmanship; it is now realized that they were deliberately spiraled. Tylor (*9*) proposed that the spiraling was a kind of rifling to give the arrow truer flight and perhaps even to eliminate the need for feathers. But the spiraling does something more: conventional Indian arrowheads, fitted to proper shafts and shot from 34-kg bows, pass right through the usual backstop; the spiral head does not, its energy being absorbed by the corkscrewing of the