Science's Newest, Most Curious Experiments

By Leonard Keene Hirschberg

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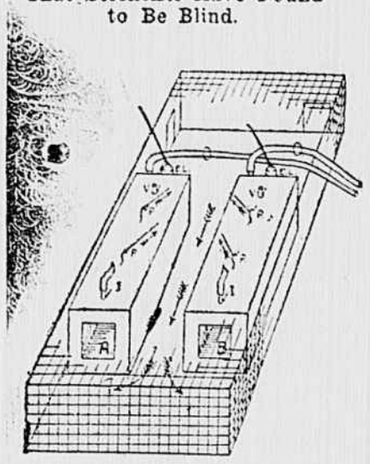
A Big Snail Showing the Eyes That Scientists Have Found to Be Blind.



Professor Yoakum's Apparatus for Testing the Effect of Temperature on Animals.

A and B. Galvanized Iron Boxes; I, Inlet for Water Supply; O, Outlet; V, Air Vent to Relieve Pressure When Water Is Admitted; EL, Electric Lights Illuminating the Tunnels Through Ground Glass; P Attachment for Cords Used In Shifting Position of Boxes. This Apparatus Showed That Lowering of Temperature Excited the Burrowing Activity in Rats.

A Dog Becomes Hypnotized by Gazing at a Revolving Spiral

MANY earnest scientists are studying the behavior of animals chiefly by the methods of comparative psychology. They are endeavoring to build up a true science of animal behavior in place of the vast body of misinformation which has been piled up by naturalists, "nature fakers" and various amateur observers.

The interesting results of their labors appear bimonthly in "The Journal of Animal Behavior," published at Boston, Mass., and a new text book, "Behavior: an Introduction to Comparative Psychology," by Prof. John B. Watson, of Johns Hopkins University, has just been published by Henry Holt & Co.

The up-to-date scientists record a great many curious facts about animal behavior without attempting to explain their meaning. In this they differ from old-fashioned naturalists, who often undertake to explain everything with the help of a little imagination or their knowledge of human behavior. The scientists are satisfied to record accurately observed facts which may form a basis for a more reliable science in the future.

The "animal behaviorists," for instance, object particularly to such a statement as this from a recent work on natural history: "Cats certainly train their young in the art of mouse killing." This, it appears, is not borne out by the careful observations of the most distinguished American "animal behaviorists."

A great variety of experiments on animals have been performed by means of mazes, which are constructed, with more or less modifications, upon the plan of the historic maze at Hampton Court Palace, in England. The animals are dropped in the place corresponding to the spot where a human being starts in the large maze and are then expected to thread their way through the maze to the central space. The length of time they take, the rate of improvement after repeated trials, and other interesing facts are noted.

Food is the usual attraction used to induce them to thread the complicated path of the maze. Many variations of the experiment are introduced. The maze is changed, for instance, and it is noted how the animal behaves when he reaches a closed spot where there was formerly an opening.

In this way it may be ascertained on what senses the animal depends in finding his way about the world, for it seems that the senses have a very different order of importance in the animal than in the human being. Practically everything we do is affected by the language habit and the process of reasoning that has been based upon it. The language habit is at least largely missing among all animals, although there is evidence that they attach considerable significance to the various sounds they make.

A typical animal maze is illustrated in a diagram on this page, together with a picture showing how it is used when a rat is the subject of experiment. Complicated blind alleys are shown at the spots marked A, B, D, E and F. It is important to notice that C is not a blind alley, but an alternate and longer way to reach the food. This is an important means of showing how quick the rat is to learn the quickest way to his food. The animal is admitted at O, food is placed at H.

As constructed for the rat, the alleys are of wood six inches in width and six inches in height. The maze was constructed so that it could be sawed across and a new section inserted so as to change the problem presented to the rat.

Studying the Mental Processes of the Rat

Dr. John B. Watson, of Johns Hopkins University, says he was struck by the peculiar rapidity and neatness with which the rat learned to thread this maze. On the average, 29 minutes were required for a first successful trip, and by the end of the thirtieth trial this time had been reduced to 30 seconds.

On early trials the animals cover every square inch of space, passing in and out of blind alleys, coming back to the entrance, advancing, returning again, etc. Soon the rat passes by the openings into the blind alleys at A and B. Gradually those further along are safely passed and finally the whole run is made without error. Experiments with light and dark mazes showed that the rat learnt as quickly in the dark as in the light, indicating that they did not depend upon sight. Blinded rats went through the maze with practically the same efficiency. Rats with the smelling organ removed and rats with their whiskers cut off went through the maze just as successfully. The investigators conclude that the rats depend chiefly on a system of "Kinaesthetic Arcs," in other words, upon a sense of direction, which is not equally well developed in human beings.

When the arrangement of the maze was changed and the places where there had been formerly openings on the correct path had been closed, the rats pushed their noses against the obstacle as if they wanted to go through. It took them about half a dozen new trials to learn the changed maze.

Many experiments seem to show that the common cockroach is a surprisingly intelligent insect. Mr. C. H. Turner has carried on tests with a maze which indicate that this clever but unpleasant insect possesses a will, can remember, and perhaps can even think.

The maze used was open, i. e., there were no walls surrounding the runways. It contained several blind alleys, some of which were complex. When in use the maze was supported by means of slender glass pillars above a wide pan of water, so that if the roach fell off the runways it was sure to fall into water. The roach to be tested was always placed on the same portion of the maze, and before each trial the runways were washed with alcohol, to remove any odor that may have been left there by a roach.

When a roach was placed on the maze for the first time, it always made many mistakes, such as rushing into or falling into the water, going into blind alleys and retracing its steps when on the right pathway. Gradually these errors were eliminated and the roach took the shortest path from the place where it was placed on the maze to its cage, which was reached by a paper inclined plane.

Very Curious Behavior of the Cockroach

The investigator draws the following conclusions: (1) By arranging the trials at intervals of half an hour, a roach may be taught, within a day, to run the maze. (2) The gradual manner in which errors are eliminated would cause one to conclude that the roach learns to run the maze by the trial and error method; yet, in so doing, it utilizes sense stimuli. This is evidenced by the careful manner in which it examines (often over and over again) the corners and the edges of the maze and the space adjacent thereto. (3) At times the roach acts as though experiencing the emotion the psychologists call will. (4) Although the effects of training persists for a long time, yet the memory of the roach is poor; for, after an interval of twelve hours, marked lapses are noticed. (5) In their behavior on the maze roaches display marked individuality.

"The roach pauses at the edge of the maze and explores outward and downward with its antennae," says this observer. "It acts as though it were trying to see something at a distance, and then after a pause makes what an athlete would call a broad jump. Many roaches displayed this jumping behavior, but some were more prone to jump than others.

"This jumping attitude is so characteristic that one can always tell when a roach is likely to jump. I say likely to jump instead of going to jump, because after a roach has once jumped into the water, the jumping attitude does not always result in a spring. To see a roach which has learned to avoid rushing off the maze into the water and which will struggle hard to keep from slipping from the edge of a runway into the water, halt, reach outward and downward with its antennae, act as though it were trying to see what was beyond, pause and then jump, is food for much thought. Have we not here a conflict of impulses, and is not the jumping or refusing to jump the resultant of this conflict? Is not such a resultant what the human psychologists call an act of will?"

Many experiments were made with boxes and cages having latches requiring varying degrees of skill to open them. In some cases the latch had to be opened in order to let the animal out, while sometimes it closed the door of a box which contained some food that the animal desired. The monkeys very quickly form by their own unaided efforts such habits of manipulation, but Professor Watson says they were entirely uninfluenced by tuition.

Professor Watson noted that monkeys were fond of doing anything that made a noise, therein showing a resemblance to the child in its fondness for drums, trumpets, and other noise making instruments. A sad looking white headed Saki monkey from South America stole a large tablespoon. He was found

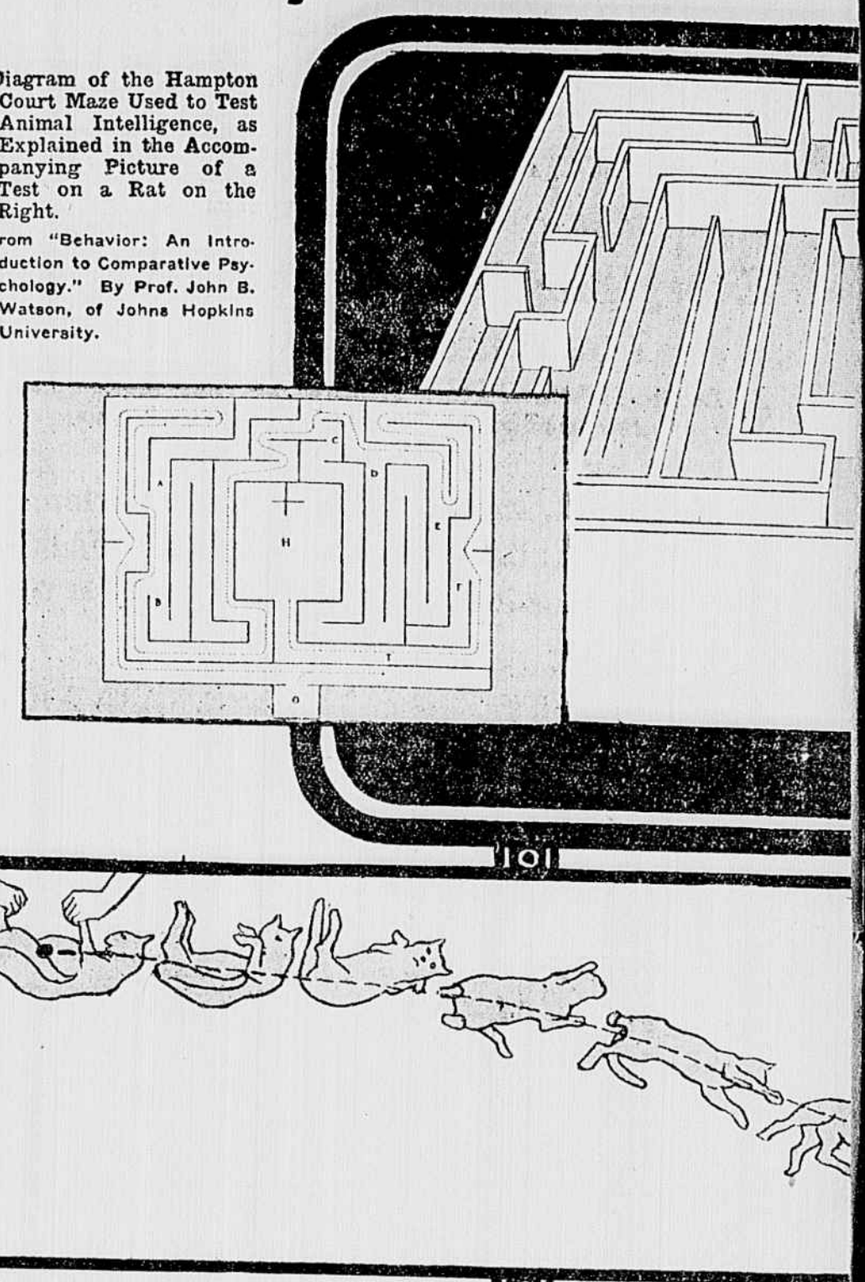
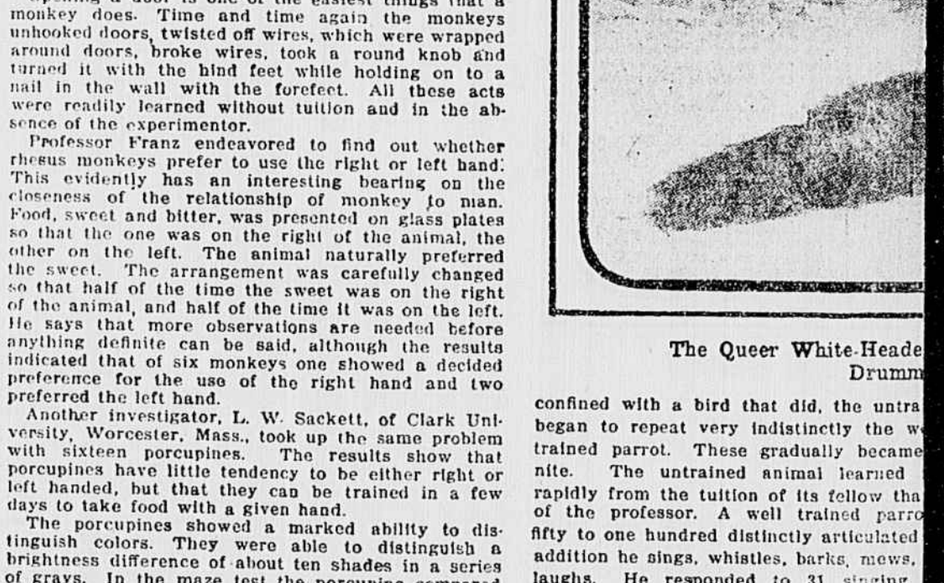


Diagram of the Hampton Court Maze Used to Test Animal Intelligence, as Explained in the Accompanying Picture of a Test on a Rat on the Right.

From "Behavior: An Introduction to Comparative Psychology." By Prof. John B. Watson, of Johns Hopkins University.



"Moving Picture" Showing How a Cat Dropped Back Downwards Turns in Falling and Always Lands on Its Feet.

standing the spoon on one end and then immediately releasing it. He repeated this act fifteen times in unvarying order at definite intervals of time. "This corresponds in our opinion," says Professor Watson, "very closely to the child's act of repeatedly hammering its spoon against the table."

Hammering with a nut or any small hard, preferably round, object was a favorite trick of the Cebus monkey. In one case the animal tapped with a small hickory nut 150 times in a half hour.

Opening a door is one of the easiest things that a monkey does. Time and time again the monkeys unhooked doors, twisted off wires, which were wrapped around doors, broke wires, took a round knob and turned it with the hind feet while holding on to a nail in the wall with the forefeet. All these acts were readily learned without tuition and in the absence of the experimentor.

Professor Franz endeavored to find out whether rhesus monkeys prefer to use the right or left hand. This evidently has an interesting bearing on the closeness of the relationship of monkey to man. Food, sweet and bitter, was presented on glass plates so that the one was on the right of the animal, the other on the left. The animal naturally preferred the sweet. The arrangement was carefully changed so that half of the time the sweet was on the right of the animal, and half of the time it was on the left. He says that more observations are needed before anything definite can be said, although the results indicated that of six monkeys one showed a decided preference for the use of the right hand and two preferred the left hand.

Another investigator, L. W. Sackett, of Clark University, Worcester, Mass., took up the same problem with sixteen porcupines. The results show that porcupines have little tendency to be either right or left handed, but that they can be trained in a few days to take food with a given hand.

The porcupines showed a marked ability to distinguish colors. They were able to distinguish a brightness difference of about ten shades in a series of grays. In the maze test the porcupine compared most favorably with other animals. They were able to follow the path in the dark when they had learned it in the light, and learning in the dark differed little from that in the daylight.

That the power of smelling is 24,000 times the power of tasting was proved by experiments on the tongues of dogs.

Why Cats Always Fall on Their Feet

The surface of the stomach and intestines both in man and the higher animals has no feeling. Any pain you may feel from those regions is due to stretching of deeper tissues.

Cats are color-blind in the daytime. Male crows proved more intelligent than females.

Professor John Trumbull Metcalf, of Princeton, has found that cold makes animals uncomfortable more quickly than heat. The results indicate that the "pain receptors" lie nearest the surface, and those for cold come next and those for warmth and pressure lie deepest.

By means of the moving picture camera Professor Binet, of Paris, showed that the cat's marvellous power of falling on its feet was due to the suppleness of the animal's spine. The head and shoulders turned first and the hind part of the body followed.

Professor Yerkes found that the male dancing mouse is somewhat more sensitive to punishment than is the female, but the maze habit was acquired by the female more quickly than by the male.

When an Amazon parrot which did not talk was

The Queer White-Heade Drumm

confined with a bird that did, the untra began to repeat very indistinctly the w trained parrot. These gradually became nite. The untrained animal learned rapidly from the tuition of its fellow tha of the professor. A well trained parro fifty to one hundred distinctly articulated addition he sings, whistles, barks, mews, laughs. He responded to 31 singing violin, 'cello, piano and voice, 29 times tones and two times by whistling tones.

Don, the talking dog of Gardelegen, G speak eight words somewhat indistinctly.

The hearing of dogs was shown to superior character to their vision. Two a perfect discrimination between the to "G," when sounded on a tuning fork stru when sounded on the Stern variator, ar cluded in chords. In response to the lo dogs put their forefeet on a chair and w fed; to the higher tone they were traine a low box for feeding.

Numerous observations attest the fact is keen eared. A cat was taught to another room to be fed on the sounding o set of tuning pipes, and to respond to the the same set. Cats learned to stay away names were called with the words "no fee

Horses have less musical ear than cat Cavalry horses are unable to distinguish bugle calls to which they are accustom direction by the rider.

Bats are very sensitive to vibrations quency. A high pitched whistle made violently, while lower pitched noises had n

Frogs can hear the human voice, and s made by a passerby caused them to st When one frog in a pond begins to croak soon join in. Likewise when one mem a chorus is frightened and stops, the oth silent. This indicates that the cessation is a sign of danger and is imitated jus croaking.

The Female Scorpion Taking Her Husband Home. Next Morning She Eats Him for Breakfast.