jured, as by the innocent fingering of the ubiquitous meddling visitor or by rain. Cleaning is accomplished by holding the sphere under a trickle of distilled water while scrubbing it thoroughly with a brush. The white sphere should of course be cleaned in the same way at the same time (employing another brush, free from lampblack!).

Blackened spheres thus prepared and treated have held their coefficients for several months and they should hold them indefinitely. Their rates of water loss are the same as those of the best black porcelain spheres similarly exposed. In the open the hourly rate of water loss from the white sphere may be as great as 9 or 10 cc. (for the hottest part of a dry summer day at Tucson), while the corresponding rate of loss from the black or blackened sphere may be as great as 11 or 12 cc. In the open at Baltimore, in July, the white sphere loses from 30 to 60 cc. per day and the blackened one loses about 16 cc. per day more than the white one, for the clearest July days. The daily index of solar radiation for clear summer days is about 18 cc. for Tucson and about 10 cc. for Baltimore. For the greenhouse at the latter station the average daily radiation index for January is about 1.2 cc., for July about 4.0 cc.

In this and related lines of experimentation I have been ably assisted by Mr. J. D. Wilson, of this laboratory.

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REFERRED SENSATIONS CAUSED BY STIMULATION OF THE INTEGUMENT IN NORMAL GUINEA PIGS

THOUGH the curious reflexes which tactile and pressure stimuli of the integument elicit in the normal guinea pig[1] were clear and unmistakable in their expression, yet their tentative explanation proved highly unsatisfactory until a chance observation in this study gave the clew. It was then realized that many of these responses were not the immediate answers to the original stimulus but were the result of a referred, perhaps centrally radiated, sensory impression which the primary tactile or pressure stimulus had called forth. A few experimental results will illustrate this statement.

When the skin covering the right costal margin is gently rubbed with the rounded end of a slender wooden rod, the animal being free in a spacious box, then under proper conditions the animal sooner or later swiftly wipes the right front foot backwards once or twice, the toes being spread apart. Repetition of the stimulus then causes a very rapid shaking of the foot back and forth; on further stimulation the right front foot is lifted and the animal seizes the nail of the inner toe with its teeth and pulls vigorously; at times it may seize all four front toe-nails in rotation and strip them with its teeth. Stimulation on the left costal margin causes the same reaction with the left foot. Not infrequently a crossed response to the stimulus is observed: stimulation of the right costal margin calls for the reaction in the left foot or vice versa.

Pressure stimuli applied to *one lumbo-pelvic area* may cause some or all of the following responses: lateral arching of the body, the head approaching the site of stimulation; repeated rapid seizure of the hair at the point stimulated by the lips and teeth as if seeking a parasite; the mirror picture of the above, the animal seizing the hair at the symmetrical point on the opposite, non-stimulated side; the lateral aspect of the jaw on the side stimulated is vigorously scratched by the hind leg; the ear, top of the head and the lateral aspect of the jaw is wiped repeatedly by the front foot of the stimulated side, the head being rotated so that the nose is turned towards the non-stimulated side; the wiping movement is repeated by the front foot of the opposite side or the animal may sit up on its haunches wiping the top of the head, the ears and jaws simultaneously or alternately with its front feet.

Another example of dyschiria is seen when the sacro-pelvic portion of the back is stimulated by repeated tactile stimuli (bristle): the perineal region is suddenly depressed and moved forward on the floor, or occasionally both hind legs are extended forwards and by means of its front legs the animal walks forwards, scraping the perineal area along the floor.

An instructive series of motor responses apparently due to a related shifting of referred sensory impressions may be seen when the animal is examined in a small box whose floor and sides are formed by half-inch wire netting; the box is supported at each corner by columns 7 inches high, the bases also support an inclined mirror which permits easy observation of the animal's ventral aspect. Repeated stroking of the sole of the right hind foot with the tip of a wooden rod may cause all or some of the following reactions: the right hind leg is first lifted abruptly and set down with a stamp; on continuation of the stimulation the same leg is again suddenly extended forwards, and one nail of the toes, or all of them in rotation, are seized by the teeth and vigorously pulled; the stimulation being continued, there may be only a slight or no movement of the stimulated right hind foot, but the right front foot is lifted and one or more toe-nails seized and pulled; still later a crossed response is obtained and now the left hind leg is extended forwards and the toe-nails seized and pulled

[1] John Auer, SCIENCE, 1923.

by the teeth; still later, the stimulation of the right sole being continued, the animal scratches the right shoulder with the hind leg.

The impulses caused by tactile or pressure stimuli of the integument are not only referred to other skin areas, they may be referred to mucous membranes. For example, after tactile stimulation of one, the animal may suddenly rub the same or the opposite or both sides of the nose with circular movements of the radial aspect of the fist or fists. There are also sneezes and in two instances drops of milky fluid suddenly issued from a naris (nares?). Furthermore, slow, chewing motions of the jaws are very common after tactile stimulation of the skin. At times the animal seizes and chews anything available in the neighborhood: sawdust, hay, the wooden sides of the container or the netting itself. The wide opening of the jaws occasionally observed may possibly also be associated with a type of sensation referred to the buccal cavity.

In addition to these manifestations there is evidence that at least one of the special senses apparently may be involved. When an animal is tested with tactile or pressure or both types of stimuli, one may see that the animal suddenly pauses, raises its nose high in the air and samples it in various directions; or the animal abruptly sniffs interestedly in the sawdust, often spreading the sawdust by lateral sweeps of its front legs to facilitate its olfactory investigation.

It is believed that these observations may be of value in aiding the interpretation of other normal and abnormal reflex activities.

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THE KENTUCKY ACADEMY OF SCIENCE

THE Kentucky Academy of Science held its tenth annual meeting on May 12th at the University of Kentucky, Lexington. The session was called to order at 9:30 o'clock by President Beckner.

The secretary's report showed 149 members, including 65 national members, 48 local members, 23 corresponding members and 13 honorary members. Thirty-five new members were elected.

Resolutions were passed unanimously agreeing with the resolutions adopted by the council of the American Association for the Advancement of Science with reference to their position on organic evolution. The Academy voted to hold a symposium on evolution at a meeting in Louisville, the date for which is to be determined.

The officers elected were:

President, Dr. W. R. Jillson, state geologist, Frankfort.

Vice-president, Dr. Austin R. Middleton, University of Louisville, Louisville.

Secretary, Dr. A. M. Peter, Experiment Station, Lexington.

Treasurer, Prof. W. S. Anderson, Experiment Station, Lexington.

Representative in the Council of the American Association for the Advancement of Science, Dr. A. M. Peter.

The program included an address by Dr. E. N. Transeau, head of the department of botany, Ohio State University.

The following program was rendered:

Eastern Kentucky's sea shore: LUCIEN BECKNER. The ancient shore line was described as parallel, generally, with the axis of the Cincinnati anticline and to the east of it. The general thickening of the strata eastward, with increasing distance from the shore line, was pointed out and evidence was cited of the presence of estuaries of great rivers. A very peculiar and interesting feature of the geology (stratigraphy) of Eastern Kentucky was shown by a vertical cross-section of the rock formations, extending from Lee County into Pike County, constructed by plotting well records graphically. The section shows that the deeper rocks (Devonian) continue their eastward dip into Pike County, but that this is not the case with the surface formations.

Jeptha knobs of Shelby County: WALTER H. BUCHER. The geological structure of Jeptha Knob was described as that of an upthrown fault block. The formations of which the knob itself is composed were described as horizontal and of Ordovician age. On either side of the knob evidence of faulting was observed. It was inferred that only the area included by the knob was affected by the upward movement.

The Haddix-Coalburg geosyncline: W. R. JILLSON. A study of the profile of the Haddix-Coalburg geosyncline (plotted by the writer to scale) brings out clearly for the first time the following facts: (I) This geosyncline is divisible into three units: (1) Kanawha River westward to Tug Fork, low elevations between 580 and 540 feet; (2) Tug Fork southwestward to Middle Fork of Kentucky River in Perry County, low elevations between 855 and 580 feet; (3) Middle Fork of Kentucky River to Jellico region (Tennessee line), lowest elevation 855 feet and highest elevation 1,600 feet. (II) Regional coincidence of pronounced structural highs in Floyd and Clay Counties with important developed gas fields, and lack of coincidence with large and important developed oil pools in all of its course until the Cabin Creek region of southern Kanawha County, West Virginia, is entered. (III) Coincidence of synclinal structure with all lines of major drainage from the South Fork of the Kentucky River northeastward to the Kanawha River.

Land of ten thousand sinks: W. R. JILLSON. The pitted or sink-hole characteristic of the St. Louis, Ste. Genevieve and Chester divisions of the Mississippian System in Kentucky has long been recognized. The widely ramifying sub-surface drainage developed in these limestone rocks, which are frequently of high purity, is well exemplified in the karst and cave region of Edmonson