folded and beveled by erosion indicate that they were not deposited during an occupation of the present basin by the sea but in an earlier depression of considerably different form, and long before the present basin was formed.

(*e*) The strongly folded and erosionally beveled Indio formation records a long interval of continental deposition, deformation and degradation between the deposition of the underlying marine Carrizo and the development of the landscape which truncates the Indio and on which the Colorado cone—heretofore regarded as the dam which cut off the sea—was built.

(*f*) The very late date for the depression of the Salton Basin below sea-level is made the more probable by abundant evidence of recent movement in the form of very young fault scarps cutting alluvial fans and occasional earthquakes.

It might at first sight appear somewhat improbable that, in a sinking trough, the Colorado should maintain a cone now only about thirty feet above sea-level at its lowest point and yet high enough continuously to exclude the gulf out of the area sinking below sea-level to the northwest. But only two alternatives were possible if the floor of the trough sank from above to below sea-level: either the river was or was not able to upbuild its cone as rapidly as the floor subsided tectonically and to maintain it as a dam. The size of the stream, its unusually heavy burden of sediment and the 125-mile extension of the cone which it has built southward to the head of the gulf give ample ground for believing that the river would be able to cope with the sinking of the trough and maintain the dam. If any part of the cone sank, through tectonic movements, somewhat below the normal grade line of the river, which was necessarily always above sea-level, that portion would soon be built up again during one of the frequent swings of the river down the different radii of its cone.

That the salt in the bottom of Salton Basin was in all probability derived from the evaporation of Colorado River water and not from a cut-off arm of the sea has been shown by W. H. Ross.[6]

In the light of our observations and present recorded knowledge we consider it highly probable that, instead of being a cut-off and desiccated arm of the Gulf of California, the present Salton Basin sank below sea-level while the Colorado River excluded the gulf by maintaining a dam in the form of a huge alluvial cone across the southern portion of the basin.

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[6] Carnegie Institution of Washington, Publication 193, pp. 45–46, 1914.

SEX GLANDS AND ADAPTIVE ABILITY[1]

THE purpose of our investigation[2] was to determine the relation between sex glands and adaptive ability. As the first of a series of experimental reports, the present paper deals with the effect of castration upon problem box and maze performances by the white rat. The term castration is used here in its narrow sense, meaning extirpation of the testicles of male animals. It does not include ovariectomy of the female, which will form the subject of a separate experiment.

As soon as time permits, we shall attack the same general problem by studying the effects of heat, X-ray, vitamin E deficiency, testicular elevation and the ligation of vas deferens. Some of these experiments are now in progress. Besides these, we plan to study the effect of injection of testicular extracts as well as the effect of feeding interstitial tissue. These two problems will be studied along with implantation and transplantation with reference to such questions as organotherapy and rejuvenation.

The maze and the problem box were used in our experiment because they offer two widely different problematic situations to our animals and at the same time represent the best recognized technique we have in comparative psychology. White rats were chosen as our subjects. In the future, we hope to repeat our experiments on higher animals such as dogs, monkeys, etc.

Twenty-seven male rats were used in our original experiments. They were of approximately the same age and body weight. All of them had learned Maze A in an earlier experiment. Operation was performed at the age of about five months. Twelve rats had both of their testicles removed (total castration), eight had only one testicle removed (semi-castration), while the remaining seven were put through a sham operation without being castrated, that is, an operative control. Preliminary feeding was given once daily for one week, after the operation, at the center of a single-platform problem box. Six of the totally castrated rats and the seven control animals were tested in the morning, while the other six totally castrated and the eight semi-castrated ones were left for the afternoon. Each animal was confronted with the problem box situation once daily for four weeks. Bread and milk were used as the incentive. Time was the only criterion that could be employed. It was taken with a stop-watch. The results for the problem box experiment are presented in Table I.

These data on the problem box experiment justify the following statements.

[1] Read before the Ninth International Congress of Psychology held at New Haven, Connecticut, September, 1929.

[2] The author expresses his sincere gratitude to Professor Harvey A. Carr for kind aid and interest in this research.

TABLE I

AVERAGE NUMBER OF SECONDS REQUIRED FOR SOLVING THE PROBLEM BOX

Daily average by weeks	Morning groups		Afternoon groups	
	Total castration 6 rats	Operative control 7 rats	Total castration 6 rats	Semi-castration 8 rats
First week	497	90	668	236
Second week	59	33	112	32
Third week	32	12	68	37
Fourth week	23	7.4	19	17
4 weeks Av.	153	35.6	217	80.5

(1) For the morning groups, the totally castrated rats show a poorer record than the control animals in their adaptive ability as measured by the time required to solve the problem box. The difference is very large and consistent throughout the four weeks under investigation.

(2) For the afternoon groups, the totally castrated rats show a poorer record than the semi-castrated animals in their speed of solving the problem box. The difference persists throughout the four weeks studied.

(3) The totally castrated rats of the afternoon groups show a poorer record than the totally castrated rats of the morning groups during the first three weeks, after which the difference is reversed. For a considerable time previous to the experiment, the afternoon groups were accustomed to be fed with the other groups in the morning. When the experiment began, however, it was found necessary to work on them in the afternoon. This change in their feeding habit may have been responsible for the poorer initial record of the afternoon group.

TABLE II

ORIGINAL SCORES FOR MAZE PERFORMANCE

	Mornings groups		Afternoon groups	
	Total castration 6 rats	Operative control 7 rats	Total castration 6 rats	Semi-castration 8 rats
Av. of first week—				
No. of errors	32	15.8	24	20.4
No. of retracings	18.5	6.8	11	8.7
Time in seconds	1,679.8	558.8	922.5	790.1
Av. of second week—				
No. of errors	7.3	3.3	8.1	6.4
No. of retracings	1.3	.3	.5	.4
Time in seconds	213	143	217	174
Total—				
No. of errors	39.3	19.1	32.1	26.8
No. of retracings	19.8	7.1	11.5	9.1
Time in seconds	1,892.8	701.8	1,139.5	964.1

One day after the problem box experiment, the animals were fed at the food box of Maze B for one week and trained in the maze once daily during the next two weeks. Number of cul-de-sac errors, number of retracings and time per trial were recorded. The results for maze performance are presented in Table II.

The experiment on maze performance was repeated on sixteen more animals. Eight of them were totally castrated while the other eight served as control. None of them had any previous experience with problem box or maze performance. These further results are presented in Table III.

TABLE III

FURTHER SCORES FOR MAZE PERFORMANCE

Average score for 4 weeks	Total castration 8 rats	Operative control 8 rats
No. of errors	64.4	41.7
No. of retracings	30	13.6
Time in seconds	1,873.4	1,252.2

The above data on maze performance justify the following statements.

(1) The totally castrated rats show a poorer record than the control animals in both speed and accuracy of maze performance. This difference persists throughout the two weeks tested for the morning groups of the original experiment and is also borne out by the average score for four weeks of the repeated experiment.

(2) The totally castrated rats show a poorer record than the semi-castrated animals in both speed and accuracy of maze performance. The difference persists throughout the two weeks studied.

To conclude, our data show that the totally castrated rats are inferior to the semi-castrated and the control animals in their adaptive ability as measured by the speed in solving a single-platform problem box as well as by both speed and accuracy in maze performance. As to whether the difference is due to the direct effect of the sex hormone upon the nervous system or to the change in metabolism as measured by body weight, respiratory quotient, nitrogen in the urine, etc., we shall leave for further investigation. However, Professor I. P. Pavlov's experiments, as reported at the Ninth International Congress of Psychology, on the effect of the sex hormone upon the excitability of nerve centers seem to support very strongly our first

theory, namely, the direct effect of the sex hormone upon the nervous system.

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TRANSMISSION AND DIFFRACTION OF LIGHT BY NORMAL SERUM AS A FUNCTION OF THE TEMPERATURE

THE present paper is a résumé of the results obtained by a further step in the systematical study of the psychochemical changes undergone by normal blood serum as a function of temperature.

We have shown previously[1] that: first, an absolute minimum of the viscosity was observed around 56° C., and that the specific viscosity increased rapidly after 58°; second, that the levo-rotatory power, unaffected by temperature up to 55° (for ten minutes' heating) increased abruptly, and that the increase, up to a certain point, was proportional to the temperature. Measurement of the amounts of light absorbed, and scattered at right angle by the molecules and particles in the serum, brought new evidence of the deep physicochemical changes which take place around 55°. The table expresses the results of one series of experiments. (Figures express the readings.)

Heated for	0	5	10	20	40	60 min.	
Temperature			52°				
Transmission	57,5	57,5	57,5	57,5	57,5	57,5	
Diffusion	125	125	125	125	125	125	
Temp.			55°				
Transmission	57,5	57,5	57,5	57,5	57,5	57,5	
Diffusion	125	125	125	125	125	125	
Temp.			57°				
Transmission	57,5	57,5	58,0	58,0	59,0	60,0	
Diffusion	125	125	117	108	95	88	
Temp.			58°				
Transmission	57,5	57,5	58,0	58,5	61,0	61,0	
Diffusion	125	122	115	105	83	83	
Temp.			60°				
Transmission	57,5	57,5	58,0	60,0	63,0	70,0	
Diffusion	125	105	96	85	75	56	
Temp.			62°				
Transmission	57,5	59,0	60,0	65,0	90,0	101,0	
Diffusion	125	95	83	65	53	46	(coag)
Temp.			64°				
Transmission	57,5	60,0	63,0	96,0	140,0		
Diffusion	125	90	73	56	48	(coag)	

In both cases (transmission and diffusion) the figures are proportional to $\log \frac{I_o}{I}$, I_o being the incident light, and I the transmitted or the scattered light. In the case of scattered light, the ratio $\frac{I_o}{I}$ for a reading of 125 is approximately equal to $\frac{1.000.000}{1}$. This table shows plainly that, if the optical density of the solution, $\log \frac{I_o}{I}$, increases slowly after 55° is reached, the same ratio decreases very rapidly when it applies to the diffracted light. (Of course, *decreasing* figures express *increases* in the amount of scattered light.)

Ten minutes' heating at 55° determines no increase in the scattered light, but ten minutes at 60° increases it roughly threefold. By applying Lord Rayleigh's formula connecting the amount of scattered light to the volume of the scattering particle, it is possible to express the increase in scattered light in terms of increased volume of the particle.

When this is done, and the data for different temperatures plotted against the time of heating, curves are obtained which show a decided tendency towards flattening when forty minutes are reached. On the contrary, if the same data are plotted against temperature, the curves are parallel and the increase in volume of particles, when the serum is heated for five, ten, twenty and forty minutes, is very nearly proportional to the temperature; *i.e.*, an increase in temperature of one degree determines about the same increase in the volume of the particle, between 57° and 64° C., whether the heating has lasted ten, twenty, forty or sixty minutes. The proportionality is rigorous within the limits of experimental errors—for a heating of ten or twenty minutes. A discrepancy is observed when the heating is kept for forty and sixty minutes. These curves are parallel to those expressing the changes in rotatory power.

One of the practical conclusions to be drawn from these findings is that the study of diffracted light affords a much more sensitive method for the study of phenomena occurring in the serum than that of transmitted light.

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[1] P. L. du Noüy, *J. Gen. Physiol.*, 1929, xii, 363; Ann. Inst. Pasteur, 1928, xlii, 742 and 1929, xliii, 749; SCIENCE, 1929, lxix, 552.

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