Ephedrine is, however, much less certain as a mydriatic in Chinese and Negroes. Not infrequently does it fail to produce any appreciable mydriasis. It was also found that pseudo-ephedrine, synthetic ephedrine, cocaine, and euphthalmine, are less powerful in dilating the pupil of the colored races. The results observed in diffuse daylight are summarized in Table I.

Further observations are being made under controlled illumination by accurately measuring the image of the pupil with a filar micrometer attachment in a telescope. These data corroborate the above preliminary measurements and will appear at a later date.

Howard and Lee of Peking[2] reported that ephedrine is more effective as a mydriatic in individuals with light irides than in those with dark. Their results are on the same line with ours.

[1] Middleton, W. S., and Chen, K. K., *Arch. Int. Med.*, 1927, xxxix, 385.

[2] Howard, H. J., and Lee, T. P., PROC. SOC. EXP. BIOL. AND MED., 1927, xxiv, 700.

3745

Relation of Liver to Fat Metabolism. I. Respiratory Quotient in Conditions of Liver Insufficiency.

PHILIP D. MC MASTER AND D. R. DRURY.

From the Laboratories of the Rockefeller Institute for Medical Research.

It has long been known that animals fail to survive extirpation of the liver. The recognized changes in the blood resulting from this procedure show clearly that the liver is essentially concerned with both carbohydrate and protein metabolisms. Does the organ possess a vital function in relation to fat metabolism as well?

For the purpose of solving this and other problems, a successful method of inducing liver insufficiency in rabbits has been devised, whereby slightly more than 90% of the liver is removed without demonstrable interference with the return of blood to the heart. Unless treated, the animals survive but 6 to 18 hours, dying with low blood sugar and convulsions. If given glucose, they live for varying periods up to 5 days, dying eventually in a state resembling that developing in dogs deprived of the entire liver.[1] A study of the respiratory quotient of rabbits deprived of 90% of the liver has brought out the fact that fat metabolism is carried on as readily and as rapidly after the operation as before.

The respiratory quotient of intact rabbits, fasted 3 days, was found to be low, indicating that the body metabolism was largely that of fat. Fasting rabbits were, therefore, employed for the work and, after the preliminary determination of the respiratory quotient, 90% of the liver was ablated. Six to 8 hours thereafter, when the immediate effects of operation and anesthesia had worn off, the respiratory quotient was again determined. No glucose had been given and at this time the blood sugar concentration was found to be 0.60 to 0.70 mg. per cc. In several instances another respiratory quotient was determined on the following day, 24 hours after operation. The animals in which this was done received just enough glucose by mouth to maintain the blood sugar level above the minimum compatible with life.

All the respiratory quotients were obtained by the closed circuit method, the animals remaining in the respiration chamber 1½ hours for each determination. Only those instances have been considered in which the metabolic rate remained constant before and after operation. As a further precaution, the CO_2 content of the venous blood was determined just before and immediately following the sojourn of the animal in the respiration chamber. All experiments have been ruled out in which any change in the concentration of blood CO_2 was found. The findings given below must be attributed to the true gas exchange of the animal and not to a mere retention or blowing off of CO_2 during the periods of the experiments.

The preliminary respiratory quotients of 10 fasted rabbits averaged .750, with variations between .710 and .780, indicating a considerable fat consumption. When over 90% of the liver of these animals was ablated, the respiratory quotient 6 to 24 hours later was found to average .735, with individual variations between .714 and .761. Respiratory quotients taken again the following day were always slightly lower than those taken 6 to 8 hours after the operation.

Control experiments with freshly fed rabbits upon a carbohydrate diet showed respiratory quotients close to unity before and after removal of 90% of the liver. In rabbits receiving intravenous injection sufficient glucose to maintain the blood sugar level at normal, the respiratory quotients also approximated unity. This latter finding is in accord with that reported by Mann[2] for hepatectomized dogs receiving glucose administrations. The observations were repeated, with the same precautions, on dogs fasted 24 hours and then deprived of the "main liver," about 70% of the organ. Animals with respiratory quotients of .797, .731, .739, and .752 showed 8 to

24 hours later quotients of .728, .724, .752, and .790 respectively. The experiment was also repeated on rats fasted 24 hours, but with them the blood CO_2 analyses were omitted. In 5 animals the preliminary respiratory quotients were .785, .782, .765, .731, and .756 respectively before the operation, and, .723, .747, .741, .738, and .744, 24 hours after removal of 70% of the liver. In 3 other rats, on which no preliminary tests were made, respiratory quotients of .736, .739, and .749 were found 8 to 24 hours after ablation of a similar percentage of the liver.

In the past, experimenters have sought to ascertain the rôle of the liver in fat metabolism by respiratory quotient studies made after attempted exclusion of the organ from the circulation by ligation of the abdominal aorta and other vessels.[3, 4] Since the respiratory quotient was usually found close to unity, conclusions were drawn that the presence of the liver was essential to fat metabolism. Murlin, Edelmann and Kramer[5] have shown, however, that extensive interference with the circulation brings about changes in the blood CO_2 which alone may account for the results mentioned. They point out, too, that in the rare instances in which the animals survived more than 6 hours, much lower respiratory quotients were found. One may conclude from the findings reported above that the metabolism of fat is carried on adequately in animals deprived of over 90% of the organ and eventually dying of extreme liver insufficiency. It seems highly improbable that the liver possesses any vital function in fat metabolism.

[1] Mann, F. C., *et al.*, *Am. J. Physiol.*, series of articles published 1921-1927.
[2] Mann, F. C., *Ergebn. Physiol.*, 1924, xxiii, 212.
[3] Porges, O., *Biochem. Z.*, 1910, xxvii, 131.
[4] Porges, O., and Salomon, H., *Biochem. Z.*, 1910, xxvii, 143.
[5] Murlin, J. R., Edelmann, L., and Kramer, B., *J. Biol. Chem.*, 1913-14, xvi, 79.

3746

The Mucinate Content of Saliva.

J. M. INOUYE, S. FORER, M. G. REISCHE AND E. G. MILLER, JR.
(Introduced by W. J. Gies.)

From the Biochemical Laboratory of Columbia University at the College of Physicians and Surgeons.

The method used for the determination of the mucinate content was the nephelometric procedure described by Inouye,[1] as follows: A 10 cc. sample of saliva is made alkaline with 2.5 cc. of 5% NaOH,