From these results as well as those reported by Hart and Steenbock, it would seem that the most effective method of administering a cod liver oil concentrate is to dissolve it in oil.

This is a complete report.

[1] Hart, E. B., Steenbock, H., and Hoppert, C. A., *J. Biol. Chem.*, 1921, xlviii, 33.

[2] Hart, E. B., Steenbock, H., Kletzien, S. W., and Scott, H., *J. Biol. Chem.*, 1927, lxxi, 271.

[3] Dubin, H. E., and Funk, C., PROC. SOC. EXP. BIOL. AND MED., 1924, xxi, 458.

[4] Ration No. 2249. McCollum, E. V., Simmonds, N., Parsons, H. T., Shipley, P. G., and Park, E. C., *J. Biol. Chem.*, 1920, xlv, 333.

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Effect on White Blood Cells in Rabbit by Ligation of Common Bile Duct.*

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Jones and Minot[1] have reported that in infectious jaundice, in human beings, the monocytes of the circulating blood are definitely increased in number. Using the supravital technique of Sabin[2] these findings have been corroborated in several cases in the Vanderbilt University Hospital of infectious jaundice. It has further been observed that while the monocytes found in these cases are qualitatively different from those found in the blood of patients having tuberculosis, they nevertheless show more cytoplasmic activity than is customarily the case with the monocytes of the normal individual. The three etiological explanations of these blood changes which seem most probable are: (1) that the rise in monocytes is a direct effect of the invading organism; (2) that it is a specific effect from the retained bile; and (3) that it is a result of some disturbance which has been produced in the liver. If the etiological factor in these changes is dependent upon injury to the liver, the immediate cause may lie either in the production of some injurious agent as a result of the injury to the liver cells, or to disturbed metabolic activity. The following observations are the result of an effort to determine if a specific injury to the liver, caused by a non-infectious process, will produce an increase in the number of the circulating monocytes.

* This work was assisted by a grant from the Henry Denison Medical Foundation.

Nine rabbits were carefully standardized by making repeated counts of the peripheral blood, using the supra-vital technique. These animals were then operated upon aseptically, and the common bile duct was ligated above the entrance of the duct from the right posterior lobe, so that only this lobe remained functionally active as far as bile drainage was concerned. The blood was studied at least once a day thereafter until the animals died, or until the blood picture had returned to normal. Table I shows the percentages and total numbers of the different types of the white blood cells before and after operation. It will be seen that there was a very marked rise in the monocytes, a slight fall in lymphocytes, and a moderate increase in polymorphonuclear neutrophilic leucocytes. The increase in the neutrophilic leucocytes occurred immediately after the operation, very quickly returned to the pre-operative level and was not maintained as was the rise in the monocytes. This post-operative leucocytosis is well illustrated in Fig. 1, which is taken from a perfectly typical experiment. That the rise in monocytes is the outstanding feature in these experiments is shown both by the curve in Fig. 1, and by the total numbers of the cells found before and after operation (Table I). Obviously these changes in the monocytes were relatively much greater both in the number of cells and in the duration of the elevation than were the changes which occurred in the neutrophilic group. In some of the animals there was a slight rise in lymphocytes immediately following the operation, but this elevation was never maintained for any great length of time, and must be considered as a part of the acute post-operative change which, very significantly, did not include a greater rise in monocytes than was maintained for the whole period during which these cells were so markedly elevated. In those animals which survived for a considerable period of time the monocytes eventually returned to normal and this return probably represented the period at which no further liver injury was being produced. At autopsy the right pos-

TABLE I.

Type of cell	Per cent before operat'n	Per cent after operation	Total No. before operat'n	Total No. after operation
Neutrophils	64%	69%	5129	7603
Basophils	8.4%	3.6%	684.8	400.3
Eosinophils	3.5%	2.3%	273	248.5
Lymphocytes	19%	12%	1551	1267
Monocytes	4.4%	13.1%	367.4	1421.14

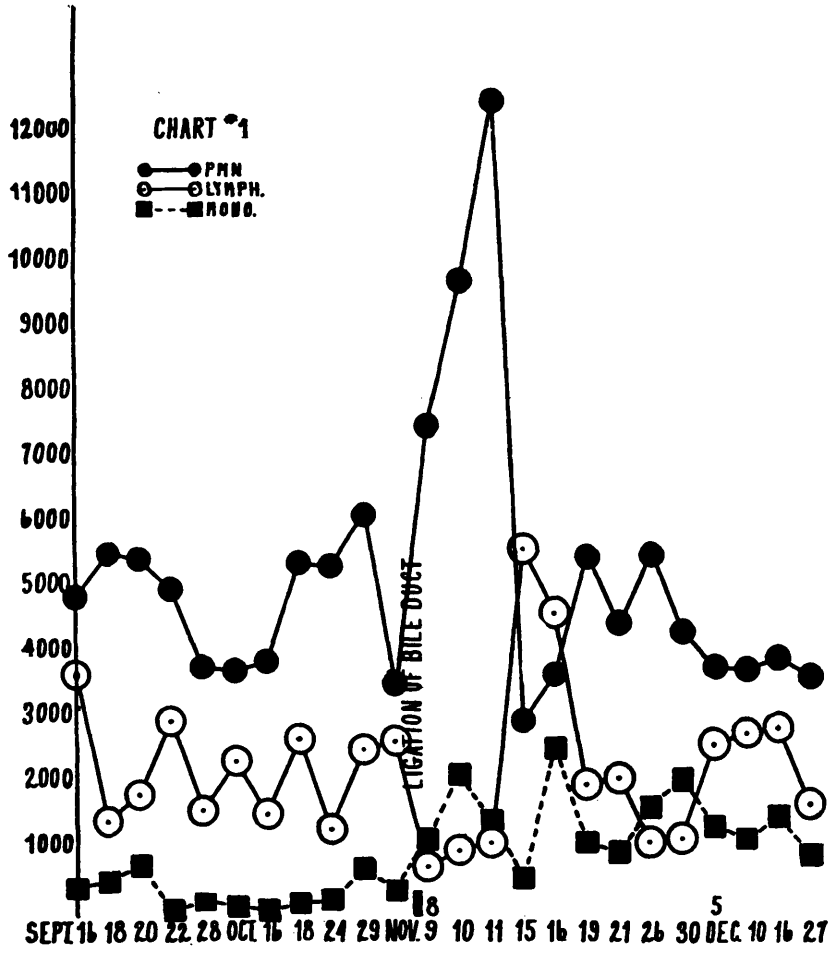

FIG. 1.

terior lobe was hypertrophied but otherwise quite normal, while the remainder of the liver showed the typical degeneration produced by complete biliary obstruction. This type of degeneration has been described so often that it need not be given in detail here. These observations indicate that ligation of the bile ducts is followed by a definite and sustained increase in the number of the circulating monocytes. That an infectious etiology is not operative here is obvious, and the explanation therefore must involve the assumption that the causative factor is either the retained bile or the injury to the liver itself.

In order to determine whether the retained bile was the cause of the blood changes, a few rabbits were given bile (both intraven-

ously and intraperitoneally) and daily counts made of the white blood cells. No changes in the white blood cells were found in these experiments. It must be admitted, however, that the amounts of bile, which we were able to give experimentally, are probably considerably less than would be absorbed as the result of such ligations as were described above. Nevertheless, if the change in monocytes is produced solely as the result of the absorbed bile, we would expect at least a slight increase in such experiments. Therefore we feel justified in concluding that the more probable explanation is that the change in the blood picture is brought about either directly as the result of the liver injury or indirectly by some interference with the metabolic activities of this organ.

[1] Jones, C. M., and Minot, G. R., *Boston Med. and Surg. J.*, 1923, clxxxix, 531.
[2] Sabin, F. R., *Johns Hopkins Hosp. Bull.*, 1921, xxxii, 314.

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Temperature Effects on Liver as a Result of Lowering Intragastric Temperature With Ice-Water.*

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Considerable work has been done in determining intragastric temperature under various conditions, but comparatively little attention has been paid to the liver. The following experiments were undertaken to determine the immediate temperature effect on the liver following the introduction into the stomach of water at a temperature of 3° C. Dogs were used for the purpose of these experiments and after having been starved for 20 hours were subjected to the following procedure.

Under ether anesthesia the abdomen was opened and thermometers placed as follows: one in the quadrate lobe of the liver, one suspended in the fundus of the stomach cavity, one inserted into a pocket in the stomach wall between the muscularis and the submucosa (except in dog number one this was not done) and of course a thermometer placed in the rectum at the time the anesthetic was started.

In order to introduce the ice-water directly into the stomach cavity a glass tube with the necessary rubber attachments was in-

* This paper was received too late to be put in regular order.