RECENT studies of iron utilization have demonstrated that intravenously administered tracer doses of radioactive iron are utilized completely for hemoglobin synthesis by afebrile, iron-deficient patients or animals, and almost completely by normal subjects. On the other hand, when hemoglobin synthesis is impaired, as in patients with refractory anemia or untreated pernicious anemia, in patients with febrile disorders, and in pigs with infection or pyridoxine deficiency, both the rate and completeness of utilization are decreased. It was discovered, furthermore, that the amount of tagged iron which appears as hemoglobin in the peripheral blood of subjects with hemolytic anemia cannot be used as a measure of iron utilization because of the rapid rate at which isotopic hemoglobin is removed from the circulation. These results clearly indicate that the radioactive iron technic for studying iron absorption, as used in the past, may give erroneously low values because only iron built into hemoglobin is measured; the assumption that this amount equals the quantity absorbed is not always justified. In the face of this new evidence, it is necessary to re-evaluate the ability of patients with impaired hemoglobin formation to absorb iron. Absorption of the metal by normal subjects should also be restudied because even though normal persons use tracer amounts of injected iron completely or almost completely for hemoglobin synthesis, absorbed iron goes into the portal rather than the systemic circulation and may, therefore, be handled in a different way. This report describes experiments designed to meet the above objections and to discover the physiologic pattern of iron absorption under a variety of pathologic influences.

The isotopic method for studying iron absorption has been extended to include not only measurement of the amount of iron converted into hemoglobin after an oral dose, but also determination of the unabsorbed portion which is eliminated in the feces. A standard dose of 1 mg. of iron per kilogram of body weight has been selected. Any portion of the test dose not accounted for in the circulating hemoglobin and in the recovery from feces represents iron that has been absorbed but not immediately utilized. With this approach, the principle that iron-deficient subjects absorb larger amounts than do normal persons has been confirmed. The amount retained by healthy men and women, however, has occasionally exceeded 10 per cent; because of the error inherent in the method, it was not possible to determine accurately how much might be stored without being used immediately for hemoglobin, but the quantity was not large. It was possible to demonstrate that patients with refractory anemia, untreated pernicious anemia,
and fever often did absorb more iron than they were able to build into hemoglobin during the period of observation. One woman with Hodgkin's disease and hypochromic anemia, for instance, retained 50 per cent of the oral dose but used for hemoglobin synthesis only one-third of the amount absorbed.

These results are of considerable theoretic interest. It is now believed that the animal organism has an extremely limited capacity to excrete iron except by hemorrhage, and that the intestinal mucosa protects the body from accumulating toxic amounts of the metal by accepting or rejecting iron according to need. The intestinal mucosa, according to this concept, is one of the major regulators of iron metabolism. Evidence indicating that patients with hypochromic anemia absorb more iron than do normal persons is compatible with this theory. However, the observation that patients with untreated pernicious anemia and refractory anemia absorb appreciable amounts of the metal in spite of the relatively large amounts of iron in their tissues, shows the regulatory effect of the intestinal mucosa to be less precise than was formerly believed.

**Material and Methods**

The subjects who volunteered for this study were healthy medical students, members of the laboratory staff, and patients on the Medical Service of the Barnes Hospital. The test dose of radioactive iron was given orally, at a level of 1 mg. of iron per kilogram of body weight, as ferrous chloride, reduced from the ferric state with ascorbic acid. The usual procedure was to give the test dose after a night's fast, but in a number of experiments the iron was given 3 to 5 hours after a meal. In one instance, through an error, the test dose was given immediately after the patient had eaten lunch and excellent absorption of the metal occurred (J. L., first dose, table 1, fig. 1). Quantitative fecal collections were made until radioactivity measurements showed that the 24 hour specimen contained less than 0.5 per cent of the activity in the test dose. In most of the subjects, fecal collections could be suspended after the sixth or seventh day. In two instances they were continued until the twelfth day. Since the method depended on getting complete stool collections, extreme vigilance was exercised by the laboratory staff. Only experiments in which there was satisfactory evidence of reliable collections have been included in the study. Blood was drawn at intervals of three days for determination of the radioactive iron in hemoglobin. The total amount of radioactivity in the peripheral blood was calculated by assuming the blood volume to be 80 cc. per kilogram of body weight. The error introduced by this assumption did not influence interpretation of results since the amount of iron found in the blood was usually small as compared with that recovered from the feces. Details of the techniques for making the radioactivity determinations have already been published.

The fresh fecal specimen was weighed and mixed thoroughly with water to which enough concentrated hydrochloric acid was added to bring the final concentration to approximately 0.6 N (50 cc. concentrated HCl per liter). The suspension was transferred quantitatively through a funnel to a liter volumetric flask, and enough water was added to adjust the volume to exactly one liter. The flask was stopped and shaken vigorously for about three minutes. As quickly as possible, an aliquot sample (one twentieth to one tenth) of the stool suspension was measured into a Kjeldahl flask. The mixture was then digested with sulfuric and perchloric acids. The cooled digest was transferred to a volumetric flask, and an aliquot portion was taken for measurement of radioactivity. Five milligrams of inert iron were added as a carrier to the aliquot in a 40 cc. centrifuge tube and the iron was precipitated with NaOH, using phenol red as an indicator. The precipitate was thrown down by centrifugation, the supernatant liquid was discarded, and the precipitate was dissolved in 0.5 cc. of 3 M H2SO4. To this solution were added in the centrifuge tube about 10 cc. of a mixture of three parts of saturated ammonium oxalate solution and one part of saturated oxalic acid solution. The precipitated calcium and magnesium oxalate salts were thrown down by centrifugation and the supernatant solution was transferred quantitatively to the electroplating cell. The precipitate of oxalates was stirred with a few drops of 3 M H2SO4 an
10 cc. of the oxalate mixture, the tube was again centrifuged and the washings were combined with the material already in the electroplating cell. From this solution, the iron was electroplated onto a copper disk and its radioactivity was measured with a Kip type Geiger counter tube.

Attention is directed to the fact that iron was not extracted from the fecal specimens by ether, as was done in certain earlier experiments. Ether extraction was unnecessary because the radioactivity in these fecal specimens was great enough to permit high dilutions of the specimens. In these high dilutions, salts other than calcium and magnesium did not interfere with the determination.

**TABLE 1.—Efficiency of Recovery of Radioiron Added to Feces**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Chemical Form of Radioiron Added</th>
<th>Method</th>
<th>Aliquot Counted</th>
<th>Radioiron Added</th>
<th>Radioiron Found</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FeCl₃</td>
<td>Ether extraction</td>
<td>1/6.75</td>
<td>64²</td>
<td>599</td>
<td>93.5</td>
</tr>
<tr>
<td>2</td>
<td>FeCl₂</td>
<td>Oxalate precipitation</td>
<td>1/50</td>
<td>64,320</td>
<td>64,320</td>
<td>100.0</td>
</tr>
<tr>
<td>3</td>
<td>FeCl₂</td>
<td>Oxalate precipitation</td>
<td>1/100</td>
<td>128,600</td>
<td>131,600</td>
<td>102.6</td>
</tr>
<tr>
<td>4</td>
<td>FeCl₂</td>
<td>Oxalate precipitation</td>
<td>1/100</td>
<td>157,100</td>
<td>153,680</td>
<td>99.7</td>
</tr>
<tr>
<td>5</td>
<td>Fe(OH)₃</td>
<td>Oxalate precipitation</td>
<td>1/5000</td>
<td>3,600,000</td>
<td>3,396,000</td>
<td>94.1</td>
</tr>
<tr>
<td>6</td>
<td>Fe(OH)₃</td>
<td>Oxalate precipitation</td>
<td>1/5000</td>
<td>3,600,000</td>
<td>3,490,000</td>
<td>97.1</td>
</tr>
<tr>
<td>7</td>
<td>Fe(OH)₂</td>
<td>Oxalate precipitation</td>
<td>1/1500</td>
<td>1,440,000</td>
<td>1,352,000</td>
<td>94.5</td>
</tr>
<tr>
<td>8</td>
<td>Fe(OH)₂</td>
<td>Oxalate precipitation</td>
<td>1/1000</td>
<td>720,000</td>
<td>668,000</td>
<td>91.1</td>
</tr>
<tr>
<td>9</td>
<td>FePO₄</td>
<td>Oxalate precipitation</td>
<td>1/2000</td>
<td>1,440,000</td>
<td>1,451,000</td>
<td>100.1</td>
</tr>
<tr>
<td>10</td>
<td>FePO₄</td>
<td>Oxalate precipitation</td>
<td>1/2000</td>
<td>1,440,000</td>
<td>1,374,400</td>
<td>95.5</td>
</tr>
<tr>
<td>11</td>
<td>FePO₄</td>
<td>Oxalate precipitation</td>
<td>1/200</td>
<td>19,500</td>
<td>17,736</td>
<td>91.7</td>
</tr>
<tr>
<td>12</td>
<td>FePO₄</td>
<td>Oxalate precipitation</td>
<td>1/1000</td>
<td>97,500</td>
<td>98,100</td>
<td>101.1</td>
</tr>
</tbody>
</table>

**TABLE 2.—The Absorption of Radioactive Iron by Patients with Hypochromic Anemia**

<table>
<thead>
<tr>
<th>Patient</th>
<th>Date</th>
<th>Hematologic Data</th>
<th>Total Test Dose of Radioiron</th>
<th>Radioiron Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>R.B.C.</td>
<td>Hb.</td>
<td>Cell Vol.</td>
</tr>
<tr>
<td>J. L.</td>
<td>2-14-45</td>
<td>4.44</td>
<td>9.1</td>
<td>32</td>
</tr>
<tr>
<td>J. L.</td>
<td>3-16-45*</td>
<td>4.23</td>
<td>8.5</td>
<td>30</td>
</tr>
<tr>
<td>O. J.</td>
<td>10-7-46</td>
<td>3.81</td>
<td>5.4</td>
<td>21</td>
</tr>
<tr>
<td>M. M.</td>
<td>3-12-47</td>
<td>3.76</td>
<td>7.1</td>
<td>17</td>
</tr>
<tr>
<td>H. N.</td>
<td>5-3-47†</td>
<td>4.93</td>
<td>7.4</td>
<td>28</td>
</tr>
<tr>
<td>S. W.</td>
<td>8-12-47†</td>
<td>4.06</td>
<td>6.9</td>
<td>24</td>
</tr>
</tbody>
</table>

* Forty-eight hours before the second test dose of radioiron, J. L. received 1320 mg. Fe as colloidal Fe(OH)₃ intravenously.
† The blood volume of J. L. and of S. W. was measured by the Evans blue dye method.
‡ H. N. vomited four hours after taking the test dose of radioiron.

Prior to October, 1946, the radioactive isotope used was Fe⁵⁹, prepared in the Washington University cyclotron. Since that time, we have used a mixture of Fe⁵⁹ and Fe⁶⁰ obtained from the Clinton Laboratories. On each day that determinations of radioactivity were made, the number of counts emitted by a standard prepared from the original iron solution was also determined several times; this value was used as the standard of reference for all calculations.

**RESULTS**

1. THE ACCURACY OF THE METHOD

Twelve recovery experiments were done to test the accuracy of the determination of radioactive iron in feces (table 1). In the first four, measured amounts of radio-
iron as ferric chloride were added to four different fecal suspensions which had been acidified with HCl. Because radioiron of weak activity was added to a large mass of feces in the first experiment, ether extraction according to the method previously described was used; ether extraction was not done during any of the remaining determinations described in this report. In the next six experiments, the isotope in the form of ferric hydroxide, ferrous hydroxide, or ferric phosphate, was added to the fecal specimen, carefully mixed, and incubated at 37°C. for twenty-four hours before the determination was made; in the last two experiments radioactive iron as ferric phosphate was added to the solid specimen and an excess of N NaOH was added. Recovery varied from 91 to 102 per cent; the form in which iron was added did not influence recovery.

Since iron-deficient subjects promptly and quantitatively utilize any iron available to them for hemoglobin synthesis, it was thought that a study of iron absorption in such a group would provide a further means of checking the accuracy of the method. In these patients, if the method is valid, the sum of the radioiron found in the circulating blood and that recovered from the feces should equal the amount given orally in the test dose. Six experiments on patients with hypochromic microcytic anemia were done (table 1, fig. 1). In only one was the recovery less than 95 per cent; this patient vomited four hours after taking the test dose and failed to save the vomitus. It is possible that a small amount of the radioiron was lost in this way. In five experiments, from 95 to 110 per cent of the ingested isotope was recovered in the blood and feces.

These two types of observations define the accuracy of the method. The error in
recovering iron from feces may be as great as 10 per cent. The sum of the amount found in circulating hemoglobin plus that recovered from the intestinal tract should not be in error by an amount greater than plus or minus 2 per cent.

2. NORMAL SUBJECTS

Absorption of radioiron was measured ten times in eight different normal subjects (table 3, fig. 2). The amount accounted for in blood and feces varied 83–100 per cent of the administered dose; in only two instances was the value less than 90 per cent. Comparison of the amount of radioiron retained by the body (activity in the test dose minus that recovered in the feces) with the amount found in circulating hemoglobin indicates that in 9 of the 10 determinations some iron was absorbed but not utilized. Even though this quantity amounted to 17 per cent in the second experiment on J. T. and was 10 per cent or more in three other instances, it was never large. Because of the error of the method, it can only be stated that the results suggest that normal persons absorb more iron than they build into hemoglobin under these conditions.

There are, however, certain conclusions which can be made with assurance. Patients with hypochromic anemia do absorb several times more iron from test doses of this magnitude than do normal persons. On the other hand, normal subjects retain greater amounts than Hahn and his associates originally indicated might be the case. Even though the intestinal mucosa may be one of the principal regulators of iron metabolism as has been suggested, it is not so efficient a regulator that it causes normal subjects to reject iron almost completely.
In three of the experiments listed in table 3, a quantity of the iron-binding globulin of plasma, Cohn's fraction IV-7,* was given intravenously either before or after the oral test dose of iron. This was done to see whether absorption would be increased if considerable quantities of this globulin were circulating during the period of absorption. The differences were not great enough to justify any conclusion; if there was an increased absorption, the increase was certainly small.

3. PATIENTS WITH ANEMIAS OF VARIED ETIOLOGY OR FEVER

Iron absorption has been studied in 12 patients selected because they had diseases in which utilization of absorbed radioiron might well have been incomplete

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* Obtained through the courtesy of Dr. E. J. Cohn.
that more iron was absorbed than could be accounted for in the hemoglobin of circulating blood. Experiments 8 and 9 demonstrate this particularly well. These two patients had Hodgkin’s disease associated with fever and hypochromic anemia.

On the basis of fecal recovery, they retained 52 and 32 per cent of the test dose, yet utilized only 15 and 2.5 per cent, respectively, to build hemoglobin.

Particular attention should be directed to the three observations on patients with pernicious anemia. The data for one of these experiments are graphically illustrated in figure 5. Shortly after administration of the test dose of radioiron, specific therapy in the form of liver extract was given. The radioactive isotope

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### Table 4.—The Absorption of Radioactive Iron by Patients with Various Blood Dyscrasias or Infection

<table>
<thead>
<tr>
<th>Patient</th>
<th>Diagnosis</th>
<th>Date</th>
<th>Hematologic Data</th>
<th>Radioiron Recovered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>R.B.C.</td>
<td>Hb.</td>
</tr>
<tr>
<td>1. S. McC.</td>
<td>Addisonian pernicious anemia</td>
<td>12-6-47</td>
<td>1.04</td>
<td>8.9</td>
</tr>
<tr>
<td>2. E. B.</td>
<td>Addisonian pernicious anemia</td>
<td>1-11-47</td>
<td>4.56</td>
<td>10.8</td>
</tr>
<tr>
<td>3. S. G.</td>
<td>Addisonian pernicious anemia</td>
<td>6-6-47</td>
<td>1.30</td>
<td>5.8</td>
</tr>
<tr>
<td>4. J. S.</td>
<td>Refractory anemia*</td>
<td>10-1-46</td>
<td>1.86</td>
<td>8.4</td>
</tr>
<tr>
<td>J. S.</td>
<td>Refractory anemia*</td>
<td>2-18-47</td>
<td>1.35</td>
<td>9.7</td>
</tr>
<tr>
<td>5. M. M.</td>
<td>Refractory anemia*</td>
<td>4-21-47</td>
<td>1.92</td>
<td>9.1</td>
</tr>
<tr>
<td>6. W. C.</td>
<td>Acquired hemolytic anemia</td>
<td>10-3-46</td>
<td>3.25</td>
<td>10.1</td>
</tr>
<tr>
<td>7. L. B.</td>
<td>Sickle cell anemia</td>
<td>8-4-47</td>
<td>3.80</td>
<td>10.7</td>
</tr>
<tr>
<td>8. D. G.</td>
<td>Hodgkin's disease</td>
<td>12-13-46</td>
<td>4.34</td>
<td>9.3</td>
</tr>
<tr>
<td>9. J. W.</td>
<td>Hodgkin's disease</td>
<td>4-2-47</td>
<td>3.41</td>
<td>5.4</td>
</tr>
<tr>
<td>10. S. D.</td>
<td>Diabetic gangrene</td>
<td>4-18-47</td>
<td>5.39</td>
<td>17.1</td>
</tr>
<tr>
<td>11. J. C.</td>
<td>Hemochromatosis</td>
<td>6-10-47</td>
<td>4.83</td>
<td>16.3</td>
</tr>
<tr>
<td>12. C. V.</td>
<td>Leukemia</td>
<td>8-20-47</td>
<td>1.90</td>
<td>5.8</td>
</tr>
</tbody>
</table>

* Secondary hemosiderosis from many transfusions.
Fig. 3. Recovery of an Oral Dose of Radioiron in Anemias of Varied Etiology
Dose, 1 mg. Fe per kg. as FeCl₂

Fig. 4. Recovery of an Oral Dose of Radioiron in Pyrexia and in Hemochromatosis
Dose, 1 mg. Fe per kg. as FeCl₂
Radioactive Iron (1 Mm per Kgm) was given by mouth as FeCl₂.
Total Radioactivity 4,800,000 counts per min.

Radioiron in Blood % of Dose

Radioiron in Feces % of Dose

Total Radioiron Recovered in Feces 84.5 %

Fig. 5. Absorption of Radioactive Iron by a Patient with Pernicious Anemia

Radioiron in Blood % of Injected Dose

Liver extract given parenterally

570 mmm Radioiron (10 mmp per Kgm) given orally as FeCl₂
Radioactivity 2,450,000 counts per min.

Days after Oral Radioiron

Fig. 6. Absorption of Radioactive Iron by a Patient with Pernicious Anemia
appeared slowly in this man's blood during a period of several months as he recovered from his anemia. If the observations had been stopped at ten days, it would have been concluded from measurement of isotopic hemoglobin that only 2 per cent of the test dose had been absorbed, yet 11 per cent eventually appeared in the blood. An even more dramatic result is illustrated in figure 6; data for this experiment are not included in table 4 because fecal recovery was not obtained.

- This patient had enough iron stored in his tissues to raise his hemoglobin from 7 to more than 12 grams per 100 cc. after specific therapy was begun, yet he absorbed more than 20 per cent of a test dose of radioiron. This fact was completely masked during the period of relapse and became evident only as he recovered from his anemia. Additional observations of a similar nature are recorded in figure 7. When the radioiron was given after therapy with liver extract, absorption was occasionally greater than during the pretherapy period.

Of particular interest also is the retention of over 2.0 per cent of the test dose by a patient with hemochromatosis while only 2 per cent appeared in his blood. Even if the fecal recovery was low by 10 per cent, he still absorbed five times as much as he built into hemoglobin. This man had diabetes, hepatomegaly, and bronzing of his skin. He had never received any transfusions to account for secondary hemosiderosis. The diagnosis was confirmed by biopsy of both liver and skin.

4. EFFECT OF LARGE DOSE OF INERT IRON GIVEN INTRAVENOUSLY ON ABSORPTION

To one of the patients with hypochromic anemia (J. L., table 2), 1345 mg. of inert iron as colloidal ferric hydroxide were given intravenously. This amount was
sufficient to increase his hemoglobin level from about 9 to over 12 grams per 100 cc. Twenty-one days prior to this injection, the patient absorbed 57 per cent of a standard test dose of radioiron (figure 8). Two days after the intravenous therapy, before he had converted much of the ferric hydroxide to hemoglobin and at a time when his tissues contained more than a gram of iron, he absorbed 24 per cent of a second test dose. Retention was less, therefore, after his tissues were well supplied with iron, but was still relatively large.

A similar result was obtained in another patient with hypochromic anemia; these data are not listed in table 2 because fecal recoveries were not done. This woman (A. D.), with a hemoglobin value of 9.4 Gm. and a mean corpuscular hemoglobin concentration of 29 per cent, absorbed 60 per cent of a test dose of radioiron in a control experiment. Six weeks later she was given intravenously 755 mg. of iron as colloidal ferric hydroxide. On the eleventh day after this procedure, when her hemoglobin had risen to 11.3 Gm. and the mean corpuscular hemoglobin concentration was 30 per cent, she was given a second dose of radioiron. Of this, 27 per cent appeared in her blood as hemoglobin. Likewise, when 480 mg. of iron as colloidal ferric hydroxide were injected into a dog with depleted iron stores, absorption was decreased from 14.9 per cent (control period) to 6.9 per cent. These results are at variance with those of Hahn and his associates who reported in one experiment that colloidal iron (304 mg.) given by vein to an anemic dog did not significantly modify iron absorption.
In other experiments done on dogs made chronically anemic by regular phlebotomy, the authors have demonstrated that the level of iron in the serum has no apparent effect on iron absorption. If the serum iron level was raised above 500 mg. per cent by intravenous administration of a soluble iron salt immediately before radioiron was given orally, absorption was not decreased (figure 9).


**Discussion**

The results of these experiments indicate clearly that patients with impaired hemoglobin formation are capable of absorbing more iron than is used for hemoglobin synthesis. The data also suggest, but do not prove, that normal subjects may occasionally absorb more iron than is built immediately into hemoglobin. Caution must be exercised, therefore, in interpreting estimates of iron absorption obtained solely by measuring the per cent of a given test dose of radioiron which appears in the circulating blood as hemoglobin. Even when these limitations are...
recognized, the isotope method is still the best one available for studies of iron absorption. Recovery of unabsorbed iron from feces, as was done in these studies, is too difficult and too time consuming to be practical. An error of approximately 10 per cent, furthermore, is involved in the recovery. If a study is to be made of the relative absorption from different iron salts, or of the effect of various influences like achlorhydria, food, the calcium-phosphorus ratio, etc., on iron absorption, the ideal procedure would be to use the isotope technic but to select only afebrile, iron-deficient patients as test subjects.

Objection might possibly be made to the experiments reported in this paper on the ground that one cannot be sure that a portion of the iron recovered in feces had not been absorbed and promptly excreted into the colon. There is abundant evidence, however, that the amounts of iron excreted into the gastrointestinal tract are minute. Any error introduced in this manner would be much less than the error of recovery per se and would be insignificant.

These results are of theoretic interest chiefly as they relate to the theory that the intestinal mucosa serves as a major regulator of iron metabolism. Granick has postulated the following explanation of absorption: the intestinal mucosal cells contain a protein, apoferritin, which combines with iron to form ferritin. The ferritin iron is thought to be in equilibrium with small amounts of ferrous ions in the cells, and the ferrous ions in turn are postulated as being in equilibrium with the iron in plasma. According to this concept, iron is taken up by mucosal cells until all the apoferritin is converted into ferritin. No more is absorbed until some of the ferritin has given up its iron to plasma. This theory explains beautifully the fact that iron-deficient subjects absorb more iron than do normal persons. It does not account adequately, however, for the equally clear demonstration that patients with pernicious anemia in relapse, with refractory anemia, or with hemolytic anemias may also absorb fairly large amounts of the metal even though their tissues are replete with iron. If the intestinal mucosa is a major regulator of iron metabolism, protecting the body from an uptake sufficiently great to cause toxic concentrations in the tissues, it at least is not as complete a regulator as it was first thought to be.

Many of the factors which control iron absorption are unquestionably still unknown. In unpublished experiments, the authors have confirmed Hahn’s observations that anemia by itself does not influence iron absorption. Uptake from the intestinal tract has been shown to be independent of the plasma iron concentration. On the other hand, if tissue iron reserves of subjects with hypochromic anemia are partially restored by the parenteral administration of large amounts of iron, uptake of the metal from the alimentary tract becomes less complete. The possibility has been explored that a factor may be present in the blood of iron-deficient subjects which stimulates absorption, but in two unpublished experiments the infusion of large amounts of plasma from iron-deficient into normal dogs has failed to affect the quantity absorbed. The mucosal block theory of Hahn and Granick remains the best explanation for all the known facts about iron absorption, but the "block" should be thought of in relative terms.
SUMMARY AND CONCLUSIONS

1. The isotope technic for studying iron absorption has been extended to measure the unabsorbed isotope in feces as well as the amount synthesized into hemoglobin. The recovery of radioiron from feces was shown to be accurate within 10 per cent.

2. There was suggestive evidence to indicate that, with the 1 mg. per kilogram dose employed, normal subjects may sometimes absorb more iron than is converted within a two week period into hemoglobin.

3. Patients with fever, untreated pernicious anemia, and refractory anemia were shown to absorb more iron than they use for hemoglobin.

4. Patients with hemolytic anemia may absorb more iron than can be recovered in the peripheral blood at any one time because isotopic hemoglobin is removed from the circulation at a rapid rate.

5. Except in afebrile patients with hypochromic anemia, acceptance of the per cent of a given dose of radioiron which appears in circulating hemoglobin as a measure of iron absorption must be made with caution.

6. The theory that mucosal cells accept iron for absorption or block its assimilation provides the best known explanation for iron absorption; but patients with adequate iron stores may assimilate considerable quantities of the metal and the block must be regarded as relative.

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IRON TRANSPORTATION AND METABOLISM

STUDIES IN IRON TRANSPORTATION AND METABOLISM: VI.
ABSORPTION OF RADIOACTIVE IRON IN PATIENTS WITH FEVER AND
WITH ANEMIAS OF VARIED ETOLOGY

REUBENIA DUBACH, SHEILA T. E. CALLENDER and CARL V. MOORE