TABLE II.
Analogies Among the A-B-O, M-N, and Rh-Hr Systems of Blood Factors.*

System*	Major agglutinogens (More antigenic)	Minor agglutinogens (Less antigenic)
A-B-O	A, B, A_1, C†	O(A_2)‡
M-N	M	N
Rh-Hr	Rh_0, rh′, rh″	Hr_0, hr′, hr″

* For simplicity the rare agglutinogens A_3, N_2, rh‴, etc., are not included in this table.
† The factor C is shared by bloods containing agglutinogens A_1, B, or both.
‡ The factor O(A_2) is shared by agglutinogens O and A_2, but absent from agglutinogens A_1 and B.

TABLE III.
Allelic Relationships Among the Landsteiner Blood Groups and Subgroups.

C-O genotypes	Reaction with serums: Anti-A_1,B (Anti-C)	Reaction with serums: Anti-A_2,O (Anti-O)	Blood groups: Phenotypes	Blood groups: Genotypes
CC	+	—	A_1, B, A_1B	A_1A_1, BB, and A_1B
CO	+	+	A_1, B, and A_2B	A_1O, A_1A_2, BO, and A_2B
OO	—	+	O, A_2	OO, A_2A_2, and A_2O

DeKromme and Van der Spek[10] also seems to be an example of natural anti-N rather immune anti-N, as claimed by these workers, considering that their abnormal antibody had the properties of a cold agglutinin.

As is well known, in the Rh-Hr system, the Rh and Hr agglutinogens are related to one another serologically and genetically like the M and N agglutinogens.[1] Of the Rh-Hr agglutinogens, the Rh factors are the more potent antigens and thus correspond to the agglutinogens M in the M-N system, while the Hr factors are the less potent antigens and correspond to the agglutinogen N (cf. table II). That similar relationships also exist in the A-B-O groups is demonstrated in Table II and Table III.

Summary. Two cases are described in which type N individuals produced anti-M agglutinins following injections at widely spaced intervals of blood containing the M agglutinogen. On the basis of these and other observations, it is pointed out that type N patients requiring a series of transfusions at wide intervals should be transfused only with type N blood, if isosensitization and consequent transfusion reactions are to be avoided. Genetic and serologic analogies among the A-B-O, M-N and Rh-Hr systems of blood factors are pointed out. Evidence is cited to show that the factors in each system fall naturally into two major subdivisions.

[10] DeKromme, L., and Van der Spek, L. A. M., *Brit. Med. J.*, 1948, **1**, 643.

16599

Cure of Ulcerative Cecitis of Rats by Streptomycin.

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Ulcerative cecitis of rats is a disease of considerable importance from two standpoints. First of all, when prevalent in a rat colony, experimental work carried out with the affected animals becomes confused, and incorrect conclusions may be drawn.

Secondly, the disease itself is of great interest. Since it is exquisitely chronic and interferes very little with the general health of the animals one has an excellent tool for the study of experimental epidemiology, the pathogenesis of infection and the effects of chemotherapy and antibiotics. Certain aspects of these questions have been dealt with in previous papers.[1-6]

In 1940-41 cecitis became prevalent in the Stanford rat colony. Very young animals were not affected, but by 4-5 months 44% of the stock had fresh lesions and the incidence increased thereafter so that 66% of 7-8 months rats showed lesions. The etiology of this interesting disease is not yet entirely clear. Cultures from the ulcerations have invariably yielded *Salmonella enteritidis*, but in spite of this we have raised the question of whether this organism alone is responsible. If bacteria of the Salmonella group freshly isolated from rats with cecitis are introduced into the drinking water of unaffected animals one produces a violent diffuse enteritis which in no way resembles the spontaneous disease. Rats which survive such an acute infection then proceed gradually to develop the usual lesions but with no greater frequency and to no greater extent than uninoculated controls.[3] Organisms, furthermore, have not been obtained from fluid aspirated from the cysts which so often develop around the cecum. It was also shown that the development of cecitis was inhibited in rats on a vitamin B deficient diet, a finding just the reverse of what one would expect with an ordinary bacterial infection.[6]

Be all this as it may, we found that cecitis could be prevented by incorporating 1% of succinyl sulfathiazole in the stock diet.[2] Sulfaguanidine 0.5% was equally effective.[1] The interesting observation was also made that if sulfaguanidine was added to the diet of the mothers during pregnancy and lactation the young subsequently failed to develop cecitis.[5] By these means the disease was eliminated from the colony and for the past three years no chemo-prophylaxis has been used.[4]

In the fall of 1947 there were indications that cecitis was again present in the colony, and the incidence was found to be as shown in Table I. The situation was even worse than in 1940 since the frequency in 4-5 months rats was now 83% as against 44% in the previous study. Furthermore, many of the animals showed very advanced lesions consisting of huge masses made up of glands, cysts containing clear fluid, omentum and thickened cecum. On opening the cecum the characteristic huge ragged ulcers were found. Cultures made from a number of the lesions all yielded bacteria of the Salmonella group in large numbers. These organisms showed the following reactions:

TABLE I.
Incidence of Cecitis in the Stanford Rat Colony, 1948.

Age of rats (days)	60	70-75	130-135
No. of rats	6	7	30
No. with cecitis	0	0	25
% with cecitis	0	0	83

glucose +	inosite —	dulcite +
lactose —	arabinose +	mannite +
saccharose —	xylose +	urea —
		indol —

and they were considered to fall in the enteritidis group. Cultures from the cecums of several unaffected rats yielded no bacteria of the Salmonella group.

The sensitivity of the Salmonella bacilli isolated from cecitis was tested with streptomycin, and the organisms were found to be completely inhibited by 5 μg per cc of culture medium. In view of this finding the following observations were made to see if streptomycin had any therapeutic effect.

Experiment I. Twenty male rats were placed on the stock diet of the laboratory. On April 8, 1948, when the rats were about

[1] Bloomfield, A. L., and Lew, W., PROC. SOC. EXP. BIOL. AND MED., 1941, **48**, 363.

[2] Bloomfield, A. L., and Lew, W., *ibid.*, 1942, **51**, 28.

[3] Bloomfield, A. L., and Lew, W., *ibid.*, 1942, **51**, 179.

[4] Bloomfield, A. L., *ibid.*, 1943, **53**, 197.

[5] Bloomfield, A. L., and Lew, W., *Am. J. Med. Sc.*, 1943, **205**, 383.

[6] Bloomfield, A. L., and Lew, W., *J. Nutrition*, 1943, **25**, 427.

TABLE II.
Cecal Lesions Before and After Streptomycin Therapy.

Rat No.	Appearance at laparotomy May 11	Appearance at autopsy May 20 after streptomycin for 9 days
75275	Mass 1.5 cm with large glands and adherent omentum	Cecum slightly thickened. No open ulcer in cecum. A little thickening of tissues at hilum. Mass is gone.
75213	Mass 0.5 cm. Small adherent glands.	A tiny hard gland at hilum. Mucosa seems a little thickened. No ulcer
7400	Cecum itself is soft, but there is an adjacent mass of glands and cysts 1.5 cm in diameter	Small cecum with adhesions and tiny remains of a gland. Mucosa slightly thickened—no ulcer
74039	Mass 1.5 cm with large glands and cyst 0.5 cm. Much matting	A small mass of firm white glands in hilum. Adhesions to omentum. Mucosa seems thickened but no ulcer
74258	A 2 cm adherent mass of cysts and glands	Mass gone. Adhesions. Mucosa seems slightly thickened. No ulcer
75536	1.5 cm mass of glands and cysts	Cecum practically normal but thickening and adhesions at hilum with a small cyst containing fluid
75775	1.5 cm mass with glands and cysts. Omentum adherent	Mucosa normal. Some scarring and adhesions outside with small hard hilar nodes
76191	Great pericecal adhesions with cyst and small mass in cecum	Cecum scarred and adherent. A large cyst containing fluid. Mucosa slightly thickened—no ulcer
76199	Mass 0.5 cm with adherent omentum and glands	Pericecal adhesions. Mucosa normal—no ulcer
77435	Huge mass nearly 3 cm in diameter. Everything matted and adherent	Remarkable resolution. Many adhesions but no glands. Mucosa much thickened. A gray area nearly 1 cm in diameter marks remains of what must have been a large encrusted ulcer before treatment
76498	0.5 cm adherent mass of glands and cysts	*No Streptomycin.* Thickened adherent cecum. Huge 2x2 cm typical green ulcer in usual situation in cecum.

130 days old one-half the group were sacrificed and the incidence of cecitis was noted. All but one of the group had definite lesions. One might expect, therefore, a similar incidence of cecitis in the remaining 10 rats. On April 12th streptomycin was dissolved in the drinking water of these animals so that each rat took on the average of 0.1 g of the antibiotic daily. The rats throve on the streptomycin and soon disdained plain water. During the 10 days of streptomycin therapy all the animals gained weight, some as much as 20 to 25 g. On April 22nd the rats were killed. In contrast to the controls sacrificed 10 days previously none of the treated animals had definite lesions with the exception of one rat which showed the faint remains of a shallow ulcer 0.5 cm in diameter and obviously healing. In rat 12 the cecum appeared normal but a slight glandular enlargement still remained at the hilum. Cultures from the cecums of five rats yielded no growth, and sections through the entire organ showed no active ulcerations except in one case in which there was a small acute shallow ulcer with complete erosion of the mucosa. However all the cecums showed infiltration of the submucosa with eosinophiles and to a lesser extent neutrophiles, evidently the remains of a healing process.

Streptomycin appears then to have a striking therapeutic effect in ulcerative cecitis of rats. However, it seemed necessary to control our observations even more precisely. The following experiment was therefore carried out:

Experiment II. A number of rats in which a clinical diagnosis of cecitis could be made on the basis of a palpable abdominal mass were collected. On April 11th, exploratory laparotomy was done on 11 animals under ether anesthesia and the condition of the cecum was carefully noted (see Table II). The incisions were closed and streptomycin was immediately added to the drinking water of 10 rats so that each animal took on the average 0.1 g daily. The remaining animal received no antibiotic. After 9 days all the animals were sacrificed. The results are shown in Table II. As in Experiment I a remarkable therapeutic effect is observed. While there were some residues of infection in the way

of scarring and adhesions, not a single open ulcer was found in the treated rats. The untreated animal (No. 76498) on the other hand showed the typical changes of active cecitis with a large ulcer.

Summary. The lesions of ulcerative cecitis of rats resolved within 10 days of streptomycin treatment. The antibiotic was added to the animals' drinking water in an average dose of 0.1 g per day per rat. The bacilli of the Salmonella group which are invariably associated with the ulcers of cecitis were sensitive to streptomycin in the test tube and they could no longer be grown from the cecums of treated rats with healed lesions.

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Simple Intestinal Obstruction: Prolongation of Life for 45 Days with Parenteral Alimentation.

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(Introduced by I. S. Ravdin.)

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The average length of survival of animals having a low simple obstruction of the ileum when allowed fluids by mouth or when given saline parenterally is around 8 to 14 days.[1,2] Death has been attributed to loss of fluid and electrolytes, possible nervous effects of distension, or the absorption of toxins from the obstructed bowel. By administering fluids, electrolytes, and nutritive material into an enterostomy below a high simple intestinal obstruction, Jenkins[3,4] has maintained animals for from 50 to 70 days. No cause for death other than the long standing emaciation was found.

We have studied the course and length of survival of animals having a simple obstruction of the ileum in which electrolyte imbalance, dehydration, anemia, and starvation were combatted by the intensive administration intravenously of sodium chloride, 5 or 10% glucose, casein hydrolysate,* blood, plasma, gelatin, and vitamins in an effort to see if by parenteral administration obstructed animals could be maintained as long as those fed by enterostomy.

Method. Ten healthy adult dogs weighing between 10.0 and 15.0 kg were used. The mid-ileum was obstructed by severing the bowel and closing the ends. Postoperatively fluids were administered daily either by intermittent rapid drip intravenously with the animal on the table or, in the later experiments, by constant intravenous drip through a capillary plastic tube threaded into the jugular vein or inferior vena cava after the method of Rhode, Parkins and Vars,[5] except that a deBakey pump was not used. The amounts of fluids and calories to be administered were determined by the output (urine and vomitus) and chemical studies on the blood, but it was not always possible to meet the requirements because of the limitations of the methods used for administration; namely, the length of time the animal

1 Harper, W. H., and Lemmer, R. A., *Bull. Johns Hopkins Hosp.*, 1946, **79**, 207.

2 Elman, R., and Hartman, A. F., *Surg., Gynec. and Obst.*, 1931, **53**, 307.

3 Jenkins, H. P., PROC. SOC. EXP. BIOL. AND MED., 1930, **28**, 111.

4 Jenkins, H. P., and Beswick, W. F., *Arch. Surg.*, 1933, **26**, 407.

* Amigen 5% in 5% dextrose solution made by Mead Johnson & Company.

5 Rhode, C. M., Parkins, W. M., and Vars, H. M., *Bull. Am. Coll. Surg.*, 1947, **32**, 255.