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The Hemopoietic Effect of Nuclear Extractives in Human Anemias*

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WITH no more than passing reference (1, 2, 3, 4) to the experimental work upon which the following clinical studies have been founded, we wish in this paper to relate briefly observations we have made on the effect of nuclear extractives in the treatment of anemia in human patients. The nuclear extractives used, as reported elsewhere, have been obtained by the methods of Hammarsten and of Kossel-Neumann from various organ sources, and have been considered to be nucleo-proteins and the sodium salts of nucleic acids. An unknown hemopoietic stimulant exists in both of these nuclear extractives, and because from both experimental and clinical suggestive evidence we have thought a greater effect upon blood regeneration was seen from the use of both extractives in combination than from the use of either one alone, we have administered to anemic patients capsules containing one-fourth gram of each extractive. In the earlier part of the clinical work we employed the intravenous injection of from one-fourth to one gram of the sodium salts of nucleic acids obtained from the washed nuclei of the blood cells of the fowl. There was observed, however, in about one-half of the patients so treated, a serum-like reaction of sufficient degree to make this method objectionable. In consequence, oral administration of the extractives was adopted with seemingly the same effect upon the blood picture.

In the entire study thus far made we have obtained nuclear extractives from eight different organs; and the percentages of extractives obtained per given weight of organ substance has been as follows: chicken corpuscles about 3 per cent, beef spleen 2.4 per cent, beef liver 1.8 per cent, beef kidney 0.9 per cent, beef heart muscle 0.5 per cent, salmon liver 2.4 per cent, beef thymus per cent and beef pancreas per cent not determined. All of the above extractives, with the exception of those obtained from beef heart muscle, have been used in the produced anemia of experimental animals. The animals have shown the same type of response in reticulated cells, hemoglobin content and in red blood cell counts that has been seen in anemic animals and in human patients with pernicious anemia to whom a high

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liver diet has been administered. The hemopoietic stimulation observed, however, has seemingly shown a more definite relation to the quantity of extractives administered than to the organ from which they were obtained. The best results followed the administration of extractives from chicken corpuscles and the next most marked results from the use of extractives from beef spleen and from salmon liver. Both of the latter extractives gave better responses than did those from beef liver. For an as yet unknown reason the extractives from thymus have given the least response of all. In the anemias of human patients we have employed thus far the extractives obtained from chicken blood cells, beef liver and beef spleen, and we have seen in these patients, for the most part, similar effects upon the blood production.

Nuclear Extractives Obtained from the Washed Nuclei of Chicken Blood Cells

It was found experimentally that the hemopoietic stimulant existed only in the nucleus of the chicken blood cell. The cytoplasm of the cell alone—and consequently the hemoglobin element of the cell—possessed no power to stimulate blood formation in the animal body. It was from the washed nuclei of the blood cells, therefore, that we obtained the first nuclear extractives used in this series of studies.

Tables I and II, respectively, give, briefly, the important data in a series of pernicious anemia patients and in a series of patients having secondary anemias. A temporary slight rise in hemoglobin and in the red cell count was observed in most of them.

Patient No. 1, table I, suffered a severe reaction from the intravenous administration of the extractives, and his blood counts showed no temporary rise in hemoglobin and red cells, as the blood of the other two patients did show. This patient had had a splenectomy done some months before. We have seen the same response from the intravenous injection of similar nuclear extractives in splenectomized rabbits. The third patient showed no more effect from the long continued use of liver than she had temporarily shown in response to the injection of 0.5 gm. sodium nucleate.

In a similar way the patients having chronic secondary anemias showed usually a temporary rise in hemoglobin and red cell content in response to one administration of sodium nucleate. In patient No. 2, bleeding uterine fibroids seemingly prevented any rise, and there was also no effect upon the blood seen from the use of liver. In patient No. 5 a temporary rise in blood count was seen to follow each of two injections of 0.25 gm. doses.

The effect of the oral administration of nuclear extractives obtained from whole chicken blood and the effect of the oral administration of the washed nuclei themselves is now being studied and a report of these observations will be made later.

Nuclear Extractives Obtained from Beef Liver

A larger number of patients with anemia have been treated clinically by us with the nuclear extractives ob-

Sodium Nucleate from Washed Nuclei of Chicken Blood Cells
Cases of Primary Anemia

Table I

No.	Date	Name	Age	Sex	Diagnosis	Hb. %	RBC	Retic. %	V.I.	Therapy	Duration of Anemia Remarks
1	10-27-26 10-29-26 11-16-26 1-13-27	AEWP	68	M	Pernicious Anemia	58 49 57 40	2.23 1.95 2.25 1.61		1.45	1 gm. Intravenously	2-3 years Severe reaction lasting three days Patient continued on liver diet without change in blood picture until his death 4-20-27. Had previously had a splenectomy and a cholecystectomy
2	11- 5-26 12- 1-26	MHC	73	F	Pernicious Anemia	72 87	2.85 3.67		1.29	0.5 gm. Intravenously	1 year Chill and fever
3	11- 3-26 11-19-26	AE	62	F	Pernicious Anemia	86 96	3.82 4.22		1.15 1.14	0.5 gm. Intravenously	3 years Chill and fever Continued on liver diet until death on 9-8-27

SODIUM NUCLEATE FROM WASHED NUCLEI OF CHICKEN BLOOD CELLS
CASES OF SECONDARY ANEMIA
TABLE II

No.	Date	Name	Age	Sex	Diagnosis	Hb. %	RBC	Retic. %	V.I.	Therapy	Duration of Anemia Remarks
1	11- 6-26	BT	39	F	Chr. Cholecystitis	69	4.41			0.5 gm. Intravenously	3 years No reaction
	12- 3-26					80	4.67				
	12-30-26					65	4.39				
2	11-23-26	CBW	39	F	Bleeding Uterine Fibroids	64	4.21			0.75 gm. Intravenously	3 years Chill, fever, vomiting Liver feeding also gave no effect
	11-29-26					57	4.48				
3	12-31-26	MM	32	F	Chr. Cholecystitis	85	4.36			0.5 gm. Intravenously	4½ years No reactions
	1- 5-27					94	4.44				
4	12-21-26	RGL	54	F	Chr. Cholecystitis	36	2.03		1.05	0.5 gm. Intravenously	6 months Chill, fever, headache Liver feeding also gave no effect. Death
	12-21-26					38	2.12				
	12-22-26					35	2.01				
	1- 5-27					27	1.34				
5	10-18-26	JP	62	F	Chr. Cholecystitis	81	3.35			0.25 gm. Intravenously 0.25 gm. Intravenously	6 months No reaction Chill for ½ hr.
	10-29-26					78	4.17				
	11-10-26					73	3.28				
	12-16-26					78	3.82				
	12-29-26					75	3.25				
6	1-20-27	BM	70	F	Chr. Cholecystitis	81	4.29			0.5 gm. Intravenously	4-5 years No reaction
	1-28-27					89	4.42				
	2- 7-27					83	3.21				
7	11- 8-26	HHN	40	F	Chr. Cholecystitis	79	4.80			0.25 gm. Intravenously	3 years No reaction Cholecystectomy 6-21-26
	3-17-27					88	4.85				

tained from other sources than chicken blood cells, and especially from beef liver, because of the greater ease of manufacturing them in quantity and also because of the present interest in the liver treatment of pernicious anemia. (See tables III and IV, and graphs 1, 2, and 3). We have been able in several instances to run like cases as rough clinical controls. We have also on several occasions treated a given patient with nuclear extractives from liver, from spleen and by liver feeding for stated periods of time to compare if possible the relative stimulant effect of the different substances. In the main, both in the case of primary anemia and in that of secondary anemia like effects have been noted. Our study of pernicious anemia patients during the past year has shown a variation in individual response seemingly due to the fact that a number of the patients had been eating liver before coming to us. In these patients the rise in the reticulated cells has been modified or absent. Case 6, table III, illustrates this point well. Case 7 indicates the necessity of using sufficiently large doses of the extractives.

Patients with secondary anemias showed a less uniform response to the administration of nuclear extractives, and to liver feeding, than did patients suffering from pernicious anemia. However, those patients who had suffered an acute anemia from hemorrhage, from an acute and transitory infection, or even in certain instances in which the cause has not been recognized, have shown quite as dramatic a response to treatment as any person with pernicious anemia. Compare, for example, in table IV, cases Nos. 5, 6, 7, 8, 9, 10, 11, 12, 14, 15 and 16. Rough clinical controls have been run as of cases Nos. 10-A, 13-A, 14-A, 15-A, and 16-A. The identical twins, Nos. 13 and 13-A were under observation and control very unsatisfactorily but an obvious improvement was noted in the treated patient over the progress of the untreated one. The anemia of chronic cholecystitis did not seemingly respond much until after the gallbladder was removed. Then, however, the patient treated with nuclear extractives, or with liver feeding, seemingly regained a normal blood content and a clinical recovery more rapidly than the patient not so treated. The same statement may be made in regard to patients with anemia due to uterine fibroids, hyperplastic sinusitis, etc. This point is stressed because there is now a widespread suspicion that the use of liver or its extractives holds a certain specificity for pernicious anemia and that persons suffering from secondary anemias are unimproved by their use. This suspicion is wholly at variance with our experience. Surely, case No. 6 belies this assumption, for the child had been treated for months with dietetic and medicinal measures without effect and the use of 3 gm. daily of nuclear extractives for a period of seven weeks produced quite as noteworthy a response in blood content and clinical recovery as could be seen in pernicious anemia. We have been of the opinion that the probable cause of failure to gain on the part of some persons with secondary anemia lies in the relative balance be-

SODIUM NUCLEATE AND NUCLEOPROTEIN FROM LIVER
CASES OF PRIMARY ANEMIA

TABLE III

No.	Date	Name	Age	Sex	Diagnosis	Hb. %	RBC	Retic. %	V.I.	Therapy	Duration of Anemia Remarks
1	11-28-27	JE	80	M	Pernicious	35	1.15			450 cc. whole blood	44 years
	12-10-27				Anemia	35	2.26			450 cc. whole blood	Left hospital feeling well
	12-15-27					43	2.26			1 gm. tid increased	
	1- 9-28					72	3.68			to 2 gm. tid in one	
	3-22-28					83	3.79			week	
2	2- 8-28	WL	62	M	Pernicious	41	1.73	1.3	1.23	2 gm. tid	Second relapse of anemia
	2-15-28				Anemia	43	2.08	8.0			Graph No. 1
	2-22-28					73	3.16	24.0			Left hospital feeling well
	2-24-28					104	5.12	2.0			
3	1-29-28	EC		M	Pernicious	38	1.26			1 gm. tid	
	1-26-28				Anemia	43	1.43			2 gm. tid	
	1-30-28					50	2.04			3 gm. tid	
	2-28-28					90	4.36				
	3-26-28					90	4.40				Continues to feel well
4	2- 2-28	OP		M	Pernicious	28	1.03			High protein diet—	
	2-23-28				Anemia	25	0.97			profoundly ill	
	2-27-28					28	1.02			Iron citrate	
	3-12-28					57	2.28			4 gm. tid—started	Marked clinical improve-
	3-26-29					80	3.19			6 gm. tid	ment

TABLE III, Continued

5	4-13-27	KAD	79	F	Pernicious	56	2.14		1.33	2 gm. tid	Acute relapse for 2 wks.
	4-15-27				Anemia	62	2.30				Death—with rising hemo-
	4-18-27					70	2.07				globin
6	3-14-28	ELP	42		Hyperplastic	114	4.50	0.1		Previous	Weakness, dizziness and
	3-21-28				Sinusitis					liver feeding	anemia, since Nov. 1927
	3-30-28				Dental sepsis	93	4.43		1.14	and liver	Radical antrum op.
	4-13-28				Pern. Anemia?	87	4.17	0.3		extracts	Dental extraction
	4-28-28					81	4.21	6.	1.14	Off liver 1 week	Marked clinical improve-
						90	4.10			Off liver 2 weeks	ment
										3 gm. tid	
7	9-10-27	LHS		M	Pernicious	42	1.47			1 gm. tid	Marked clinical improve-
	9-20-27				Anemia	41	1.32			1.5 gm. tid	ment
	10- 1-27				Diabetes	61	1.88				
	10-10-27					66	2.35				
	10-29-27					83	3.25			2 gm. tid	
	11-12-27					90	3.58				
	11-25-27					91	4.17				
	12-20-27					100	3.82				

SODIUM NUCLEATE AND NUCLEOPROTEIN FROM LIVER
CASES OF SECONDARY ANEMIA

TABLE IV

No.	Date	Name	Age	Sex	Diagnosis	Hb. %	RBC	Retic. %	V.I.	Therapy	Duration of Anemia Remarks
1	4- 2-27	JK	69	F	Chr. Chole-	76	4.12			1 gm. tid	1 year
	4-10-27				cystitis	91	4.66				
2	4- 4-27	GC	45	F	Uterine	84	4.65			1 gm. tid	3½ years
	4-11-27				Hemorrhage	88	4.73				
3	3-25-27	AJL	38	F	Chr. Chole-	75	4.40			0.5 gm. tid	3 years
	4- 7-27				cystitis	84	4.62				
4	3-15-27	GLS	50	F	Uterine	59	3.89			0.5 gm. tid	6 months
	3-17-27				Fibroid	61	3.98			1.0 gm. tid	Hysterectomy 4-11-27
	4- 1-27					73	4.66				
	4- 9-27					65	4.26				
5	4-13-27	JC	1.5	M	Upper Resp.	52	5.01			0.5 gm. tid	3-4 months. Graph No. 3
	6- 9-27				Infection	95	6.12				Health rapidly regained
											Failure of previous therapy
6	12-31-26	BP	2	M	Malnutrition	38	3.40			1 gm. tid	6 months
	2-20-27				Upper Resp.	98	5.68			1 gm. stopped	Health rapidly regained
	4- 8-27				Infection	100	5.86				Failure of previous therapy
7	4-26-27	BP	13	F	Unknown	72	3.92			1 gm. tid	1 year
	5-24-27				Cause	96	5.74				Severe menstrual flow
	6- 1-27					90	5.25				

TABLE IV, Continued

8	5-19-27	W	24	F	Unknown	57	3.95			0.6 gm. tid	2-3 years, periodically
	6- 9-27				Cause	92	5.24				
9	7-18-27	LR	26	F	Hemorrhage	20	1.41			550 cc. whole blood	Acute onset
	7-25-27				Peptic Ulcer	38	2.64			1 gm. tid	
	8-20-27					74	4.42				Gastroenterostomy
	8-22-27					58	3.60				
	9-10-27					94	5.24				Discharged
10	8- 3-27	IW	19	F	Hemorrhage	32	1.95			2 gm. tid	Acute onset
	8-29-27				Abortion	64	3.40				
	9-13-27					95	5.24				Discharged
10-A	8-30-27	Mrs. D	28	F	Hemorrhage	51	2.98	3		Curettement	Acute onset
	9-30-27				Abortion	64	3.89	4			Used as control
	10- 8-27					68	4.00				Discharged
11	2-22-28	CB	47	M	Lobar	111	5.28			2 gm. tid	Anemia following lobar
	3- 6-28				Pneumonia						pneumonia
	3-20-28					48	3.52				Graph No. 2
	4- 2-28					60	4.08	12			
						86	6.08	3			Discharged
12	8- 7-27	LZ	45	M	Cellulitis	48	3.02			2 gm. tid	Anemia following cellulitis
	8-17-27				of Thigh	95	5.14				Discharged

TABLE IV, Continued

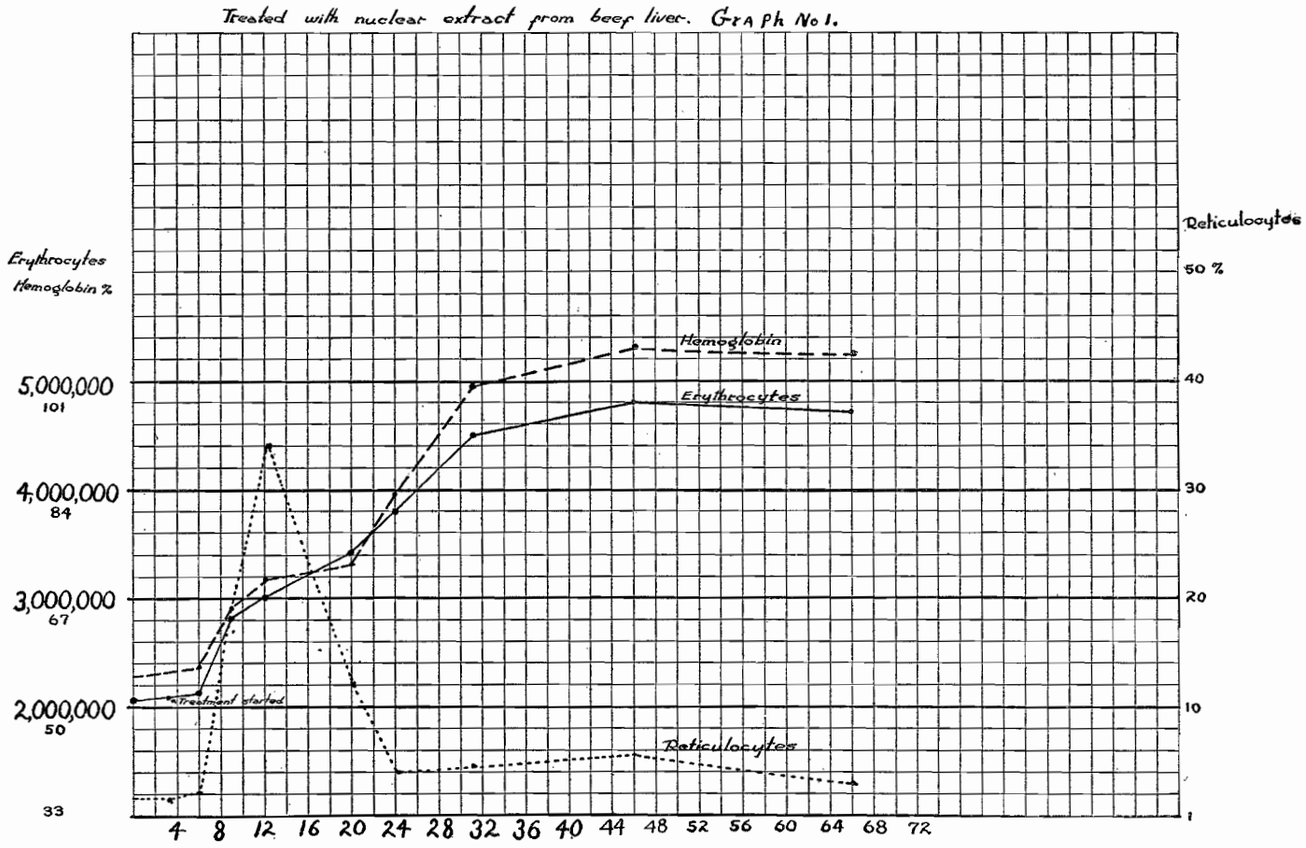
13	10-12-27	Martha	1	F	Nutritional	38	2.96		1 gm. tid	Identical twins
	11-14-27				Disturbance	50	4.20			
	1-11-28					55	4.80			
13-A	10-12-27	Mary	1	F	Nutritional	38	3.19		Dietetic tr. only	Used as a control
	11-14-27				Disturbance	40	3.80			
	1-11-28					40	4.70			
14	12- 9-27	FA	22	M	Hemorrhage	19	1.28		500 cc. whole blood	Acute onset
	12-15-27				Peptic Ulcer	30	2.30		2 gm. tid	Marked clinical improvement
	12-20-27					50	3.22			
	1-11-28					75	4.98			
	1-17-28					89	5.24			
14-A	12-20-27	CB	32	M	Pulmonary	40	2.52			Acute onset
	12-23-27				Hemorrhage	36	2.62			Case used as a control
	1-11-28				Cause	40	3.03			
	1-17-28				Unknown	46	3.24			Slow recovery
15	8- 7-27	LZ	21	F	Following	52	3.02		2 gm. tid	Acute onset
	8-10-27				Acute Peri-	84	4.37			
	8-17-27				tonitis	96	5.14			Rapid recovery
15-A	8-26-27	LH	19	F	Acute	30	1.92		Transfused	Acute onset
	8-28-27				Hemorrhage,	40	2.10		whole blood	Used as control
	8-31-27				Abortion	58	2.50			Slower recovery

TABLE IV, Continued

16	11- 8-27	FLW	48	F	Hyperplastic	73	4.15			Anemia several years
	11-15-27				Sinusitis					Radical antrum operation
	11-30-27					52	3.75		2 gm. tid	Secondary hemorrhage
	12- 5-27					47	2.87			Liver ext. stopped
	12-21-27					69	4.05		liver 1 lb.	Discharged—good recovery
	1-7-28					89	4.65			
16-A	3-20-28	AM	23	F	Purulent	60	4.02	4	Intra-nasal	Acute secondary hemorrhage
	4-20-28				Sinusitis	54	4.52	5	puncture	Used as control
	5-24-28					72	5.10	3		Slow recovery
17	3-17-28	CZ	63	F	Carcinoma	48	3.74	6	2 gm. tid for 12	Discharged
	4-23-28				Stomach	44	3.54	3	days	
	4-30-28					60	4.24		3 gm. tid for 19	
	5-12-28					76	4.68		days	
									Partial	
									gastrectomy	
18	10- 6-27	AN	25	F	Sickle cell (?)	62	3.75		1 gm. tid	Anemia for at least 10 yrs.
	11-12-27					71	4.02			Graph No. 3
	12-12-27					76	4.35			Severe menorrhagia
	1- 6-28					79	4.48			
	2-22-28					68	3.50			Very fair clinical improvement
	3-22-28					80	4.56			

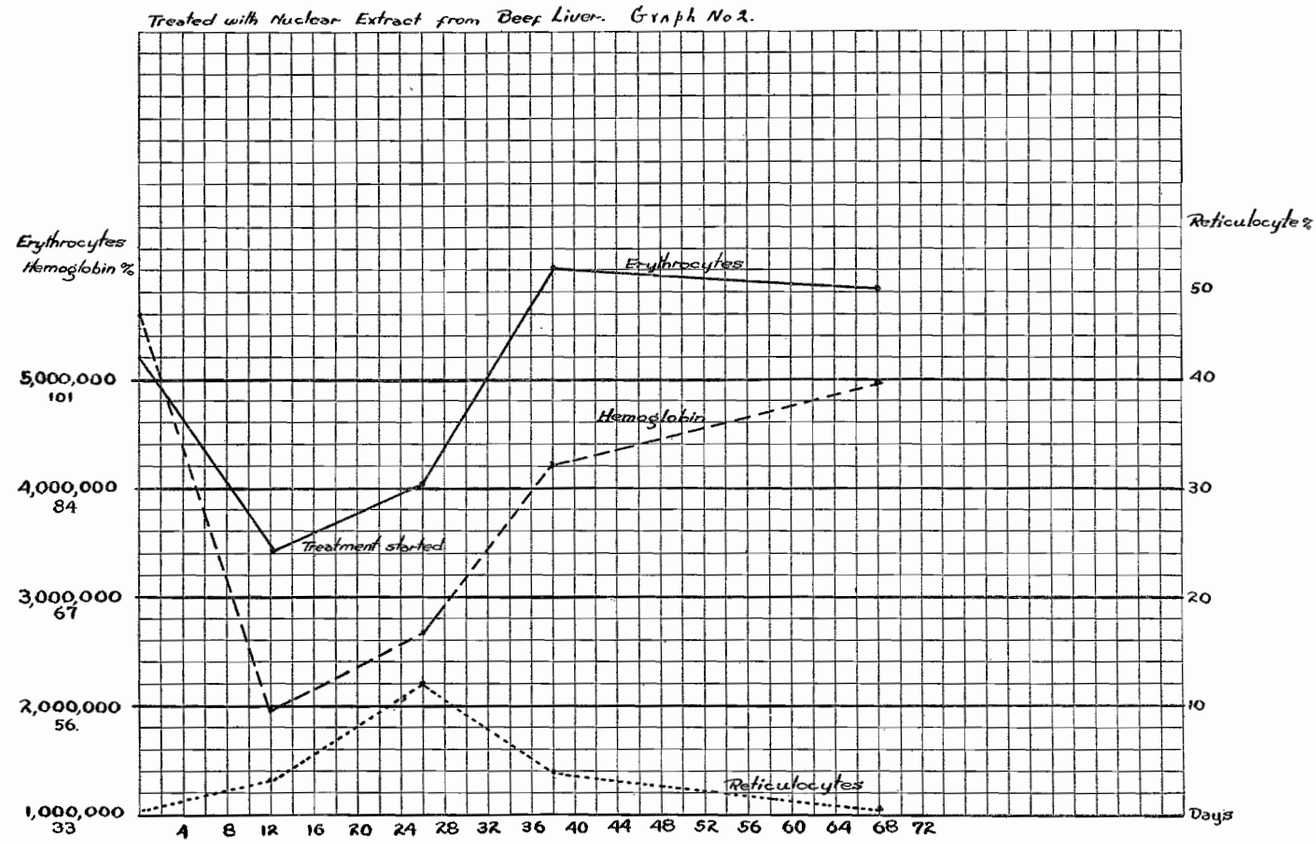
W. L. - Male - Age 62 - Pernicious Anemia

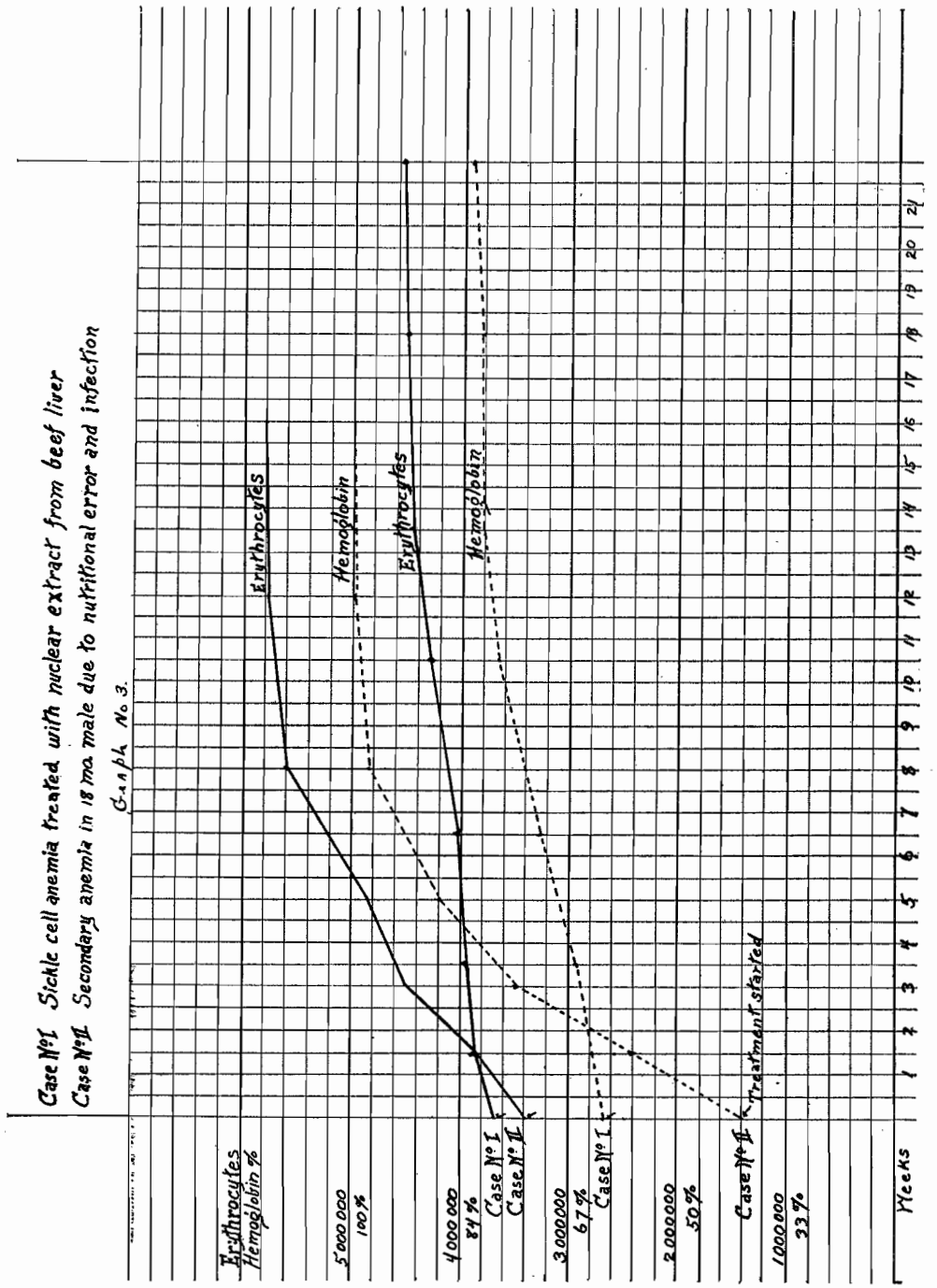
Treated with nuclear extract from beef liver. Graph No 1.



C.B. Male - Age 47 Anemia following lobar pneumonia.

Treated with Nuclear Extract from Beef Liver. Graph No 2.





tween the cause of the anemia operating and the capacity of the hemopoietic centers of the bone marrow to respond to stimulation. Case No. 17, a woman with carcinoma of the stomach, made no gain on 6 gm. nuclear extractives daily in 12 days, but after partial gastrectomy, showed a gain of 32% hemoglobin and 1.14 million red cells on 9 gm. of the same extractives in 19 days. The control cases 10-A, 14-A, 15-A and 16-A might suggest that the patient would not have shown this gain had she not been so treated.

Case No. 18, a young white woman suffering from a chronic anemia which simulated sickle cell anemia (to be reported by Drs. Hunter and Adams from the Department of Pathology, University of Oregon) showed marked clinical improvement under the administration of 1 gm. liver extractives three times daily. Gastrointestinal distress disappeared, the pallor of her skin and mucous membranes became much less marked and the hemoglobin and red cell content progressively increased, over a period of five months, from 62 to 80 per cent and 3.75 million to 4.56 million respectively. Under no other form of treatment had improvement ever been observed.

Nuclear Extractives Obtained from Beef Spleen

Six patients suffering from pernicious anemia have been treated by the use of sodium nucleates and nucleoproteins obtained from beef spleen. A resumé of their data is given in table V. Graph No. 4 illustrates the progress under treatment of patient No. 1. Two patients present the same initial rise in reticulocyte count, the rapid gain in hemoglobin and red blood cell content, and the same clinical improvement observed from high liver feeding. Patients No. 2 and 3 had previously eaten liver, and the increase of the reticulated cells was delayed and less high than in patients Nos. 1 and 4 who had not eaten liver. Patient No. 2 was given spleen extractives, 9 gm. for 4 days and 12 gm. for 14 days, with a rise of 15% hemoglobin; then liver extractives 9 gm. for 15 days, with a rise of 22% hemoglobin; then spleen extractives 9 gm. for 9 days with a rise of 5% hemoglobin, at which time she returned home on liver feeding. Patient No. 3 was given 9 gm. spleen extractives for 14 days and showed a gain of 14% hemoglobin; then 9 gm. liver extractives for 4 days with a gain of 5% hemoglobin, then for 10 days, 9 ounces of raw liver was given, with a gain of 4% hemoglobin, and finally for a period of 21 days 3 vials of Lilly's liver extract were added to the 9 ounces of raw liver with a gain of 5% hemoglobin. The numbness and tingling of the hands and feet, from which this patient suffered, did not disappear. We have seen the paresthesia disappear twice in pernicious anemia patients; once from liver feeding and once from the use of the nuclear extractives obtained from spleen. For the most part, however, we have seen no effect upon the symptoms of cord lesions.

Discussion. In presenting at this time this brief report of our clinical observations on the use of nuclear extractives obtained from different ani-

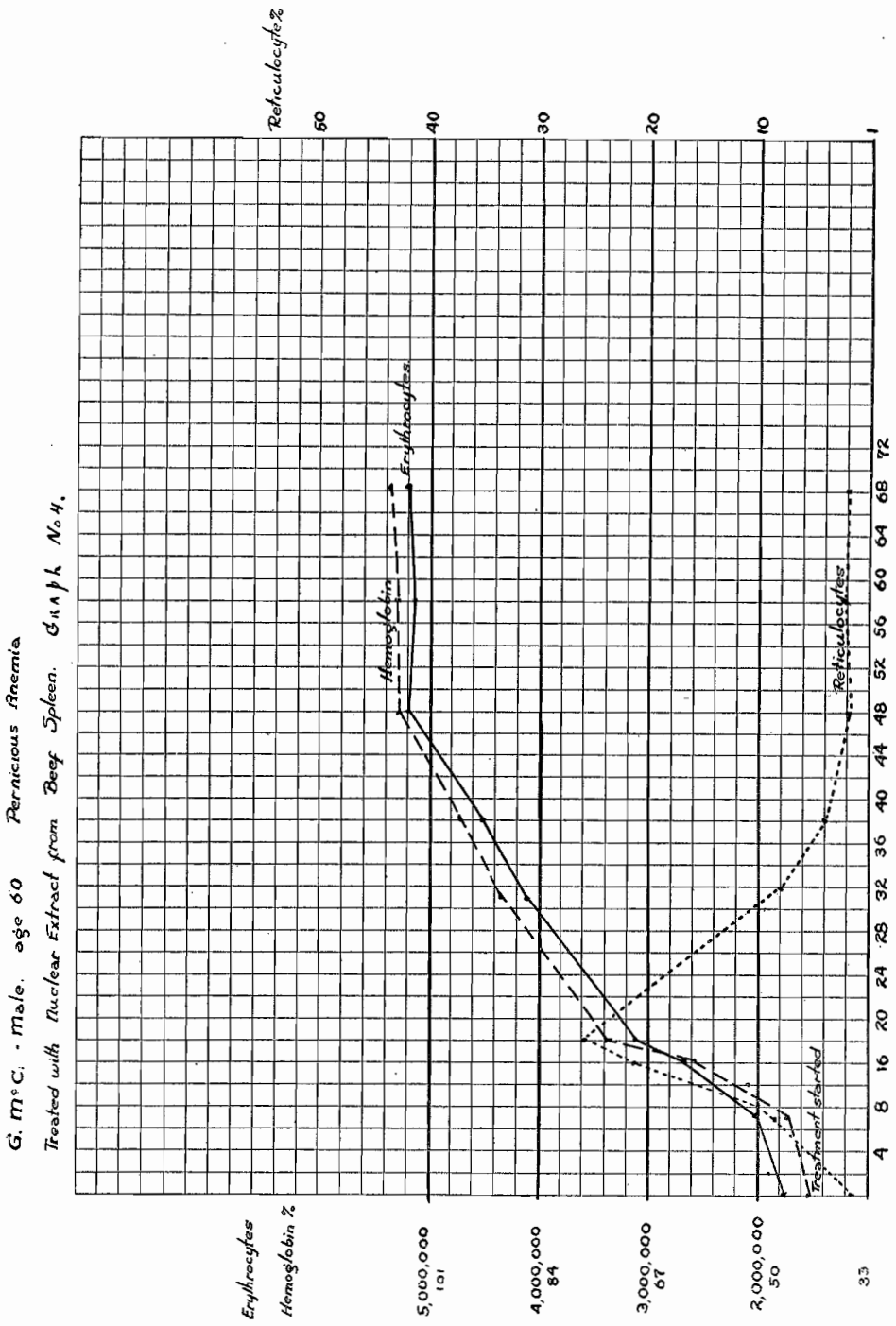
SODIUM NUCLEATE AND NUCLEOPROTEIN FROM SPLEEN
CASES OF PRIMARY ANEMIA

TABLE V

No.	Date	Name	Age	Sex	Diagnosis	Hb. %	RBC	Retic. %	V.I.	Therapy	Duration of Anemia Remarks
1	3-14-28	NMcC	58	M	Pernicious	56	2.16	1.4	1.18	3 gm. tid	Duration 3 years
	3-17-28				Anemia	66	2.80	20.			Graph No. 4
	3-20-28					70	3.00	34.			
	3-28-28					75	3.41	12.			
	4- 4-28					83	3.80	4			Marked clinical improve-
	4-11-28					100	4.50	4.5			ment
2	3-29-28	KMcC	70	F	Pernicious	47	1.80	0.1	1.34	3 gm. tid	Duration 5 years
	4- 2-28				Anemia	55	1.94	2.0		4 gm. tid	Had previously eaten liver
	4- 9-28					54	1.96	6.6			Marked clinical improve-
	4-16-28					62	2.18	11.0		3 gm. tid liver ext.	ment
	4-27-28					79	3.20	6.0		(replaced spleen)	
	5- 1-28					84	3.14	4.0		3 gm. tid spleen ext.	
	5- 9-28					89	3.15	2.0		(replaced liver)	
3	4- 2-28	EPL	54	F	Pernicious	69	2.59	0.2	1.36	3 gm. tid	Duration 2 years
	4- 6-28				Anemia	77	3.00	0.4		3 gm. liver ext.	Had previously eaten liver
	4-11-28					80	2.86	2.2		tid (replaced spleen)	and taken Lilly's liver ext.
	4-16-28					83	3.33	1.0		9 oz. raw liver daily	Some general improve-
	4-20-28					87	2.96	2.4		(replaced liver ext.)	ment—Numbness of ex-
	4-25-28					85	2.89	3.2		3 vials Lilly's liver	tremities continues
	4-30-28					91	3.33	3.7		ext. added to raw	
	5- 4-28					93	3.42	3.0		liver	
	5-21-28					96	3.70	1.9			

TABLE V, Continued

4	4-22-28	AA	72	F	Pernicious	58	1.86	1.6	1.52	3 gm. tid	Duration (?)
	4-30-28				Anemia	66	2.37	11.0			
	5- 8-28					74	3.06	14.0			Marked clinical improve-
	5-22-28					90	4.03	8.0			ment
5	6-15-28	GP	72	F	Pernicious	28	0.90	7.8	1.22	3 gm. tid	Duration several months
	6-21-28				Anemia	33	1.40	10.0			Marked clinical improve-
	6-29-28					46	2.46	9.0			ment
6	5-21-28	ST	55	F	Pernicious	45	1.80	1.0	1.17	3 gm. tid	(Started 5-25-28)
	6- 1-28				Anemia	58	1.96	4.0	1.14		Marked parasthesias
	6-15-28					64	2.21	13.4			All parasthesias gone
	6-21-28					80	3.42	7.0			Marked clinical improve-
	6-29-28					84	3.49	5.0			ment



mal sources in the treatment of human anemias, we have been actuated mainly by the fact that our experience is at variance with the clinical reports thus far published by others. The experimental work of Leake, Bacon and Evans, Robscheit-Robbins and Whipple and by ourselves (5), and the results obtained by McCann (6), all point to the belief that there are one or more factors common to bone marrow, spleen, liver, chicken blood cells, kidney, etc., which have similar hemopoietic effects upon the animal body. Nuclear extractives are common to all of these substances. The facts that such extractives obtained from the washed nuclei of chicken blood cells have this hemopoietic stimulant effect markedly and that the cytoplasm of the blood cell does not possess it at all are especially suggestive.

If we can tentatively conclude anything from our limited work, both clinical and experimental, it is that the hemopoietic stimulant, unknown as yet as to its composition, is an integral part of the cell nucleus, and that the effect noted upon blood production from the taking of different animal tissues depends upon the amount of nuclear substance contained in that particular meat eaten. Liver has shown, in our experimental work, a greater stimulant effect than pancreas and thymus, but less than that of spleen; and the greatest effect, thus far noted, has been obtained from the washed nuclei of the blood cells from the fowl. A practical point may be suggested from this observation, namely, that liver alone, which is often repugnant to persons, may be replaced by the eating of kidney, sweetbreads, spleen and possibly beefsteak. The use of expensive pharmaceutical products may therefore be in part avoided.

One more point of importance seems to be logically deduced from our work. The results indicate a like response from the administration of these nuclear extractives in both primary and secondary anemias. Modifying factors may enter both groups and prevent or alter type blood reactions.

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