were compared by statistical analysis and proved to be significant. The differences in mean survival of the old and middle-aged group, 3.8 days, is 2.8 times the probable error of that difference, and the odds against occurrence by chance are about 15 to 1. The difference in mean survival of the middle-aged and young groups, 8.2 days, is 6.1 times its probable error and the odds against chance occurrence are very high. More striking still, the difference in mean survival of the old and young groups, 12.0 days, is 10.8 times the probable error of the difference and the odds against occurrence by chance are extremely high.

The differences noted cannot be attributed to sexual differences in expectancy as pointed out by Berg[2] since the experiments were terminated quickly by the acuity of the disease; furthermore, the young animals of the second experiment, which might have been expected by Berg's criteria, to die the earlier, proved to be the more resistant. It should be emphasized also that the inoculating dose per animal was the same in mass. Calculating on the basis of mg of bacteria per kg of body weight, the young animals received 7.7 times the dose given to the old and 3.3 times the dose given to the middle-aged group. Since all other conditions of the experiment were the same in the 3 groups, the differences noted must have been due to variations in resistance with age.

Conclusion. Resistance to tuberculosis, as measured by survival-time of guinea pigs after intracerebral inoculation, varies with age. Young animals are the more resistant, and susceptibility increases progressively with age.

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Hypoglycemic Response of Patients Using Protamine Zinc Insulin to Induced Hyperglycemia.

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Some of the difficulties encountered in treating diabetes could be attributed to rapidly fluctuating blood sugar levels. The slow acceptance of protamine zinc insulin by the clinician was, in part, due to the occurrence of hypoglycemia episodes. They can be differentiated into two groups, the nocturnal, and the post-prandial. The

[2] Berg, W. N., *Am. Rev. Tuberc.*, 1938, **37**, 259.

former are obviously due to the unopposed prolonged action of Prozinsulin during the long fast from the evening meal to breakfast. An explanation for the latter type is given below.

Fifty-two diabetic patients using protamine zinc insulin exclusively for routine control were selected at random for the experiment. This consisted in the administration of 210 g to 420 g of orange juice, (25 to 50 g of glucose) 24 hours after the last insulin injection. Blood sugar estimations were made by the Somogyi (1936) modification of the Shaffer-Hartmann method in the fasting state, and at 0.5-hour intervals for 4 hours. The results shown in Table I with the controls, represent illustrative types of blood sugar variations seen in this series of experiments.

TABLE I.

				Mg glucose/100 cc blood							
Date	Patient	Gm orange juice	Fasting	½ hr	1 hr	1½ hr	2 hr	2½ hr	3 hr	3½ hr	4 hr
10-12	N.G.	420	192	224	254	259	216	171	160	154	149
9-2-37	E.S.	420	114	179	214	255	261	178	160	150	140
9-9	R.R.	420	219	260	287	294	266	178	155	119	109
10-2	A.M.	420	90	145	221	209	184	173	127	111	109
8-26	C.R.	420	86	165	210	194	140	132	99	80	77
10-6	J.Z.	420	205	273	299	279	244	209	190	197	129
9-10	N.R.	420	110	135	201	160	139	128	107	60	68
12-1	S.S.	420	334	380	339	326	324	311	303	263	257
9-3	S.B.	420	221	247	285	240	225	204	178	163	150
11-17	M.S.	420	134	197	252	227	173	141	105	105	104
10-13	S.F.	420	218	247	282	263	236	209	196	176	143
11-18	I.R.	420	193	203	247	244	228	212	184	179	173
8-13	S.S.	210	115	135	195	222	182	145	140	129	114
9-1	A.W.	420	97	111	137	125	104	73	71	65	62
12-20	E.G.	420	52	102	119	88	74	65	59	54	64
11-16	H.M.	250	107	125	151	182	165	155	136	119	94
8-27	J.L.	420	77	114	139	124	103	100	98	78	73
8-24	D.S.	210	80	125	200	153	128	120	110	80	62
11-13	D.D.	420	119	153	195	194	195	174	194	194	185
3-1	F.Y.	Control	133	133	158	156	164	150	148	153	154
3-1	L.P.	,,	125	127	133	138	122	124	126	128	130
11-1	M.B.	,,	190	160	155	151	150	177	180	200	215

It is evident that the peak rise in the first 0.5 to 1.0 hr and the subsequent fall to fasting, or below fasting levels by the 3.0 hr resembles the normal glucose tolerance curve. In fact, many of the curves cannot be distinguished both in absolute change and contour from non-diabetic ones. Another point to be noted is that the rapidity of the rise has a direct bearing on the rate of fall, independent of the original blood sugar level. That is, the sharpest peak rise in blood sugar level is followed by the most precipitous drop. During the test period, patients with such curves manifested hypoglycemic symptoms. It will be noted that in the control curves where no food was given to the patient, the blood sugar level remained essentially unchanged for the 4-hr period. It must be assumed that the amount of exogenous insulin present was the same both in the test period after orange juice, and in the control period. Apparently the rise in blood sugar level caused by the ingestion of glucose stimulated the glucose-disposing mechanisms. When the stimulus produces an exaggerated response the clinical symptoms of hypoglycemic shock appear.

It can be concluded that the too rapid rise in blood sugar concentration can be responsible for the post-prandial hypoglycemias. As a corollary, it may be stated that hypoglycemia can be avoided by dietary regulation directed toward slowing the availability of the carbohydrate. Evidence is being accumulated to show the practical clinical application of these conclusions.

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Blood Glucose and Lactic Acid in Relation to Milk Secretion.†

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The recent *in vitro* synthesis of lactose by Petersen and Shaw[1] from lactic acid and glucose and the demonstration by Graham[2] of the loss of lactic acid from the blood traversing the mammary gland indicates that lactose is synthesized in the gland from lactic acid and glucose of the blood.

Kaufman and Magne[3] found that in lactating animals the mammary venous blood contained less glucose than the jugular blood. Loss of glucose from the blood in passing through the lactating mammary gland has also been shown by Blackwood and Stirling,[4] Lintzel,[5] and Graham, Jones and Kay.[6] The latter workers reported that the amount of glucose taken out of the blood was proportional

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* The data in this paper are from a thesis presented by J. C. Shaw in partial fulfillment of the requirements for the degree of Doctor of Philosophy, University of Minnesota, Minnesota Agricultural Experiment Station.

1 Petersen, W. E., and Shaw, J. C., *Science*, 1937, **86**, 398.

2 Graham, W. R., Jr., *J. Biol. Chem.*, 1937, **122**, 1.

3 Kaufman, M., and Magne, H., *Compt. Rend. Acad. Sci. Paris*, 1906, **143**, 779.