mony with those tabulated below in Table I, in which we believe there is increased accuracy and great convenience for repetition.

Table I shows data from normal dogs except for one anemic (39–299) and one splenectomized (39–194). It is significant that the *red cell volume* as measured by dilution of the injected labelled red cells is almost the same after ten *minutes* as after one to three *days*. Average differences between these two values amount to only 3 per cent., and one hesitates to attach real significance to variations within 5 per cent. This would indicate that in the usual healthy dog the number of *immobilized red cells* in marrow, spleen and other vascular spaces does not exceed 10 per cent. of the circulating mass and may be considerably less.

It has been recognized that the true body hematocrit is always definitely below the jugular hematocrit, but this has always been a theoretical figure. If we divide the determined circulating red cell volume by the sum of it and the determined plasma volume, we arrive at a value for the *average body hemotocrit*. It can be seen in Table I that this is always lower than the hematocrit in the jugular blood, and sometimes considerably so. It follows that the mean hematocrit of the capillaries, arterioles and venules must be decidedly lower than the average body hematocrit shown in Table I.

The last column gives the ratio of the *true* circulating red cell volume and the red cell volume calculated from the plasma volume and jugular hematocrit. The average value of this ratio is 0.77, which means an inherent error of about 25 per cent. in red cell volumes values calculated from the plasma volume.

It is obvious that this method can be used to study human physiology, normal and abnormal. One must have a suitable donor with a large mass of red cells containing radio-iron. This perhaps is not an easy specification, but given a supply of red cells labelled with radio-iron some interesting observations could be made on shock, polycythemia, circulatory failure and other abnormal states.

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TABLE I

COMPARISON OF CIRCULATING AND TOTAL RED BLOOD CELL VOLUMES DETERMINED DIRECTLY AND INDIRECTLY

Dog	Red blood cell volume by radio-iron: Circulating 10 min.	Red blood cell volume by radio-iron: Total 1–3 days	Red cell volume calculated from plasma volume	Plasma volume by dye	Wgt.	Hemoglobin level	Jugular hematocrit	Body hematocrit	Ratio red cell volumes†
					kg	gm %	%	%	
36–196	290	280	365	565	12.6	14.5	39	34	0.79
39–307	445	405	500	480	13.5	19.9	51	48	0.89
39–144	255	250	400	485	8.0	15.5	45	34	0.64
39–193	585	680	905	890	17.0	21.5	50	40	0.65
39–88	465	515	615	520	15.0	21.6	54	47	0.76
39–194*	375	...	490	720	17.1	14.6	40	34	0.77
40–149	380	(340)	425	525	10.7	15.1	45	42	0.89
39–299	155	180	170	645	14.5	6.1	21	19	0.91
Averages	370	380	485	605					0.79

* Splenectomized dog. Probable Bartonella infection which caused destruction of injected cells and did not allow a determination later for computation of total red cell volume.

† Ratio of red cell volume determined by radio-iron to red cell volume calculated from plasma dye volume and jugular hematocrit.

THE TURNOVER OF ACID-SOLUBLE PHOSPHORUS IN THE KIDNEYS OF RATS

THE mechanism whereby phlorhizin blocks the reabsorption of glucose by the renal tubules is still unknown. The hypothesis that this effect is due to an inhibition of the phosphorylating mechanism in the kidney[1] was not supported by later studies.[2,3] In order to investigate the possible connection between the phosphorus metabolism of the kidney and the mechanism of glucose reabsorption, the influence of phlorhizin on the exchange of phosphorus in the kidney, using radioactive phosphorus (P^{32}) as an indicator, was studied.

If the reabsorption of glucose in the kidney tubules is dependent upon some phosphorylating mechanism, then the formation and breakdown of organic phosphorus compounds must occur at a rapid rate. Hence if phlorhizin exerts its effect upon glucose reabsorption by inhibiting the phosphorylating mechanisms, the rate of phosphorus exchange should be diminished.

To test such premises, rats were given intravenous injections of phlorhizin dissolved in 0.1 N NaOH. Fifteen minutes later a solution containing radioactive phosphorus[4] in the form of sodium phosphate was injected subcutaneously. Thirty minutes later the ani-

[1] E. Lundsgaard, *Biochem. Zeits.*, 264: 209, 1933.

[2] E. Lundsgaard, *Skand. Arch. Physiol.*, 72: 265, 1935.

[3] A. M. Walker and C. L. Hudson, *Am. Jour. Physiol.*, 118: 130, 1937.

[4] For the supply of radioactive P we are indebted to Dr. L. A. DuBridge and Dr. S. N. Van Voorhis, of the Department of Physics, University of Rochester.

mals were sacrificed and the kidneys were removed and frozen in a carbon dioxide-ether mixture. The frozen kidneys then were powdered and extracted with trichloroacetic acid, and aliquots of the extract were taken for determination of the phosphorus fractions. The radioactivity of the various fractions was measured by means of a Geiger-Müller counter (designed by Dr. W. F. Bale, University of Rochester). The activity of the phosphorus compounds was determined likewise in a control group of animals, treated in an identical manner except that sodium bicarbonate instead of phlorhizin was injected intravenously.

In the kidneys of the phlorhizinized rats the turnover of the pyrophosphate fraction (that hydrolyzed in 7 minutes by N acid) was found to be decreased. This was determined by comparing, per mg of P, the radioactivity of the pyrophosphate fraction with that of the inorganic phosphorus. The other fractions of the acid-soluble phosphorus determined apparently were not affected. In a control group of 9 animals the pyrophosphate fraction in the kidney displayed radioactivity which was 70 per cent. of that of the inorganic phosphorus in the kidney. In the group of 9 phlorhizinized rats, the radioactivity of the pyrophosphate fraction was only 33 per cent. of that of the inorganic phosphorus. Thus, the turnover of the pyrophosphate fraction in the kidneys appears to be less in the phlorhizinized animal than in the normal animal, indicating that phlorhizin exerts *in vivo* an inhibitory effect on some phases of the phosphorylating mechanisms of the kidney.

These findings can not be regarded as conclusive evidence that the blocking of glucose reabsorption is due to an inhibition of phosphorylating processes in the kidney. All that can be stated at the present time is that the inhibition of glucose reabsorption in the kidney coincides with a decrease in the turnover of one fraction of the acid-soluble phosphorus. Studies are now in progress to determine whether a more definite correlation between the two phenomena does exist.

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AN INVERSE DISTANCE VARIATION FOR CERTAIN SOCIAL INFLUENCES

1. THE GEOGRAPHICAL DISTRIBUTION OF COLLEGE UNDERGRADUATES

THIS study began with an examination of the geographical clustering around the alma mater of the residences of undergraduates in recent classes at Princeton and Harvard, and of alumni of Harvard, Princeton, Vassar and Yale. The examination uncovered a remarkable inverse distance "law" or statistical regularity.[1] *The number of undergraduates or alumni of a given college who reside in a given area is directly proportional to the total population of that area and inversely proportional to the distance from the college.*

This rule holds with reasonable closeness as far as Texas for the four colleges studied. The 11 Rocky Mountain and Pacific Coast states, however, are represented by about half a dozen times more alumni, and two or three times more undergraduates, than the trend with distance "entitles" them to.[2]

I define the "potential" of the population of a given area, at a given point, as the population of the area, in millions, divided by the average distance, in miles, from the point to the area. Evidently the above "law" is equivalent to the statement that the contribution of a given state to the quota of undergraduates (or alumni) of a given college is proportional to the state's "potential" at the college town.

For particular purposes the "potential" of a *special group* of the state's total inhabitants may be used. Thus for eight recent consecutive undergraduate classes at Princeton the accumulated percentage of undergraduates, p, who have residences closer to Princeton than a given radius is well represented, in percentage points, by[3]

$$p = 7.3 + 482\,U \tag{1}$$

Here U is the accumulated "potential" out to any given radius of the *native white male populations,* state by state, in the order of increasing distance (Table 1):

TABLE 1

COMPARISON OF NATIVE WHITE MALE "POTENTIALS" WITH THE GEOGRAPHICAL DISTRIBUTION OF THE RESIDENCES OF PRINCETON UNDERGRADUATES

Distance from Princeton, N. J., in miles	Accumulated "potential" U millions/mile	Actual percentage of undergraduates within given radii	Computed percentage p of undergraduates	Percentage of total population
95 (N.Y.)	0.085	48	48	17
150 (Md.)	.130	70	70	31
380 (N.C.)	.149	78	79	45
515 (Mich.)	.160	83	84	58
950 (Mo.)	.177	93	93	70
1,500 (Tex.)	.185	97	97	90

[1] *The Princeton Alumni Weekly,* 40: 409–410, February 9, 1940.

[2] Four Princeton undergraduates assisted in the examination of alumni distribution: C. D. MacCracken, Philip Wilkie, M. S. Dillon, R. B. Snowden. A somewhat more detailed discussion of this distribution will appear in the *Bulletin of the American Association of University Professors.*

[3] Theoretically p should reduce to zero for U zero. However, the average distances when small can be found only with considerable labor. Furthermore, beyond Texas the rule breaks down. It is fair therefore to adjust, as in (1), for the intermediate range of 1,400 miles.