methoxylated polygalacturonic acids," as mentioned in the National Formulary VII, p. 316.)

This point is confirmed and made more clear by observations made in this laboratory in connection with studies on the transfusion treatment of shock with pectin sols[1, 2, 3] (autoclaved and clarified for control of molecular size and sterility). Our previously published method[4] has made it possible to obtain the data on the uronic acid contents of livers, as given in table 1.

TABLE 1

Source of samples	Mg uronic acid per gram of liver: Individual specimens	Mg uronic acid per gram of liver: Average	Remarks
Suckling rabbits (composite sample from 4 animals)	...	1.5	Note increase in uronic acid content when diet changes to include plant material known to contain galacturonic acid.
Adult rabbits (on commercial rabbit ration)	17.3 38.5 28.3 19.0 27.2		
		26.1	(Herbivorous)
Human, normal adults	5.6 7.3 4.4		
		5.8	(Omnivorous)

The uronic acid in infant rabbit livers is no doubt glucuronic, but the tremendous increase following the use of a diet containing grains, alfalfa and other plant material must certainly result from galacturonic rather than glucuronic.

The logical conclusions from this would be that in the omnivorous human the uronic acids in tissues and fluids would also include galacturonic. Thus, intravenously injected pectin (a polygalacturonide) would not be a source of substances as foreign to the human body as would some of the other plasma substitutes which have been given consideration. This is in harmony with reports that a considerable proportion of injected acacia remains in the liver,[5] a situation not found with pectin,[1] a substance of easily hydrolyzable galacturonide nature. Spleen enlargement and alteration may take place in some cases immediately after pectin injection,[6, 7] but there is later a return to normal.[8]

The significance of the distribution of the individual uronic acids in tissues of animals having different basic feeding habits offers an interesting field of study. A consideration of this general subject would lead to a better understanding of human metabolism.

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6 Data being prepared for publication by the Hektoen Institute of Cook County Hospital, Chicago.

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8 Work now in progress in our laboratory.

PRODUCTION OF GLYCOSURIA IN NORMAL RATS BY MEANS OF ADRENOCORTICOTROPHIC HORMONE[1]

THE production of glycosuria and hyperglycemia in normal rats by the administration of large amounts of 17-hydroxycorticosterone and 17-hydroxy-11-dehydrocorticosterone has been reported.[2, 3] We have been able to duplicate these effects with pure adrenocorticotrophic hormone.

Normal male rats of the Sprague-Dawley strain having an initial weight of 300 grams were force-fed a fluid diet which represented approximately 15 grams of available carbohydrate per day. The adrenocorticotrophic hormone was prepared by the procedure described by Li, Evans and Simpson.[4] Following a control period of ten days the hormone was injected subcutaneously in amounts of 1 mg every two hours until a total of 7 mg per day had been administered. Five rats were injected with the hormone for ten days. As shown in Fig. 1, four of the five animals developed glycosuria on the second day following the beginning of injection and it was continued as long as the hormone was given. One of the rats did not develop glycosuria, although it showed a marked hyperglycemia following feeding. Two of the rats were killed at the end of the injection period. Weights for pairs of adrenal glands of 146.5 and 131.1 mg were recorded. Control weights averaged 36 mg with a

1 From the Upjohn Research Laboratories, Kalamazoo, Michigan, and the Institute of Experimental Biology, University of California, Berkeley, California.

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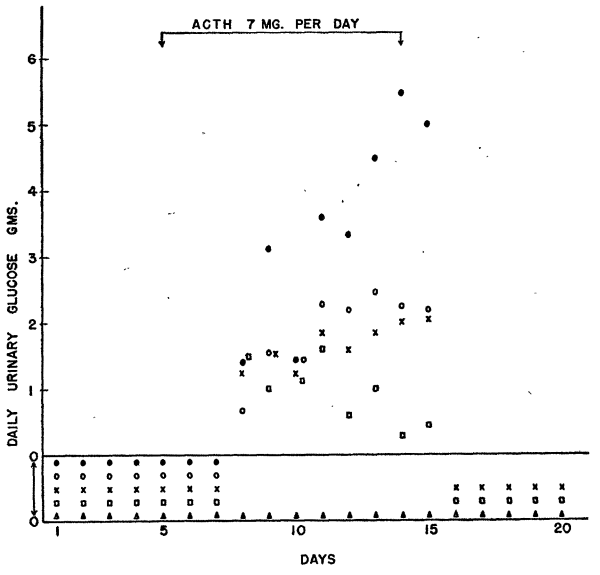

range of 32 to 43 mg. Three rats were observed for seven days following withdrawal of the hormone. The glycosuria immediately disappeared from the two animals which had excreted glucose during the injection period.

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STRAIN ENERGIES OF CYCLIC HYDROCARBONS[1]

THE strain energies of cyclic hydrocarbons have long been of interest to chemists. Since the discovery of appreciable energy barriers to rotation about single bonds, it has been apparent that this phenomenon may contribute a strain energy[2] in addition to the long-recognized deviation from tetrahedral bond angles. Conn, Kistiakowsky and Smith[2] discussed the relative energy contents of five- and six-membered cyclic hydrocarbons with zero, one and two double bonds without being able to obtain agreement between calorimetric values and theory. It is the purpose of this communication to point out that by recognizing the non-planarity of the cyclopentane ring[3] it is possible to obtain substantial agreement.

The calculations leading to the values in Table 1 are based on the well-established (though not very precise) values of 2,800 cal. per mole for the potential barrier[4] about an ethane-like single bond (staggered position having minimum energy) and 6×10^{-12} erg per radian[2] for the force-resisting[5] distortion of the bond angles about a carbon atom. Several amounts and types of puckering of cyclopentane were considered in order to estimate the energy of the stable position. In the column headed "Bond Angles" are given the energies needed to bend the bond angles below their equilibrium values. To compute the twist energy, each single bond in the ring is considered separately. The energy needed to twist an ethane molecule into a similar configuration is taken as the contribution for that bond. In considering orientations adjacent to the double bond in the olefins, it is assumed that the equilibrium position is still the staggered one (if two single bonds were bent into a two-membered ring). This is confirmed by results for the simpler olefins. While the agreement in Table 1 is not perfect, it is within the various uncertainties present.

TABLE 1

STRAIN ENERGIES (KCAL. PER MOLE)

	Bond angles	Single bond twist	Total calc.	Exper.
Cyclopentane	2.6	6.6	9.2	7
Cyclopentane (planar)*	(0.1)	(14.0)	(14.1)*	(7)*
Cyclopentene	2.6	5.6	8.2	6
Cyclopentadiene—1, 3	7	0	7	6
Cyclohexane (chair form)	0	0	0	(0)
Cyclohexane (boat form)*	(0)	(5.6)	(5.6)*	(0)*
Cyclohexene	0	1.5	1.5	1
Cyclohexadiene—1, 3	0	4	4	4

* Hypothetical, unstable forms.

The experimental values in Table 1 are based on hydrogenation data[2] for the olefins and on combustion data[6] for the two naphthenes. The basic, no-strain heat of olefin hydrogenation is taken as that of trans 2-butene. For the diene hydrogenation, the value for 1,3-butadiene is adjusted for the effect of substitution on each end with the trans 2-butene-ethylene difference.

It is planned, when circumstances permit, to refine these calculations by detailed consideration of the force constants and spectra of the molecules involved. At that time additional details of these calculations can be given.

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[1] The material in this communication was presented as a part of the American Chemical Society Award in Pure Chemistry address, Pittsburgh, 1943. Publication and further work have been delayed by war activities.

[2] J. B. Conn, G. B. Kistiakowsky and E. A. Smith, *Jour. Am. Chem. Soc.*, 61: 1868, 1939. These authors state that Dr. V. Schomaker first suggested this possibility to them.

[3] J. G. Aston, H. L. Fink and S. C. Schumann, *Jour. Am. Chem. Soc.*, 65: 341, 1943.

[4] K. S. Pitzer, *Chem. Rev.*, 27: 39, 1940.

[5] Rough average of values given by T. Y. Wu, "Vibration Spectra and Structure of Polyatomic Molecules," National University of Peking, Kun-ming (1939).

[6] H. M. Huffman, private communication.