measures of variability, and results from more than a single subject, decided that the experiment would bear repetition.

Two attempts were made to duplicate the results. In the first attempt a Goodwin Stimulator (Model No. 3) was used, which delivered an exponential discharge with an abrupt rise time and a time constant of 0.5 σ. The active electrode was a small piece of tantalum wire, doubled and drawn to a point. The inactive electrode was a small coil of tantalum wire which rested under the tongue. The anterior dorsal surface of the tongue was explored with stimuli of 0.4–3.0 v at frequencies of 100–1000 cps. Below 0.8 v no sensations were aroused, but at 0.8 v all frequencies aroused pressure or cold sensations. Sour was not in evidence until 0.9 v was reached and then was accompanied by cutaneous sensations. Sour sensations, when obtained, were either continuous or accompanied by pressure or pain which sometimes fluctuated. It would have been easy to confuse continuous sour plus discrete pressure pulses with discrete sour pulses. Similar results were obtained with a second trained subject. It was concluded that the judgment required of the subject was too difficult to permit of precise results. The first apparatus was abandoned as being unfair to Allen and Weinberg, and a second apparatus was assembled which was designed to deliver a stimulus resembling more closely the stimulus used by them.

Allen and Weinberg used mechanical control of the stimulus, whereas the present authors attempted to duplicate the essential features of their stimulus using electronic control. An audio-oscillator (Hewlett-Packard Model 200B), a square-wave generator (Hewlett-Packard Model 210A), and an attenuator (Hewlett-Packard Model 350A) were employed to deliver half a square wave, variable as to voltage and frequency. The active electrode (the cathode, as in Allen and Weinberg's study) was the same as in the first study; the inactive electrode was a double strand of tantalum wire stretched across a plastic plate on which the subject rested his tongue. A silver active electrode (similar to Allen and Weinberg's) was used in some series, with no change in results.

In the second study six subjects were used, of whom four were experienced in psychophysical judgments. They were instructed to report any and all sensations and to describe the time characteristics of any sensations experienced. As before, the anterior dorsal surface of the tongue was explored with stimuli of increasing voltage until sour was aroused. Experimentation began with 0.11 v, and the stimulus never exceeded 2.08 v. Then the frequency of the stimulus was varied from 20 to 300 cps. All subjects reported sour, seldom accompanied by other sensations, so that it was possible to observe the time course of the sour sensation. In no instance did any subject spontaneously report fluctuating or pulsing sour. When finally queried as to whether discrete pulses of sour occurred, no subject was able to observe it. For all subjects, then, sour was "fused" at all frequencies, and it thus became impossible to obtain fusion frequencies, as reported by Allen and Weinberg.

The reasons for the discrepancy in results are not obvious. It is possible that Allen and Weinberg's subject was confused by cutaneous sensations aroused simultaneously with sour. In any event, unless their results can be substantiated by other investigators, they should not be used as evidence for four taste systems nor for the relationships among the taste systems.

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Skeletal Units in Protein Crystals[1]

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Recent estimates of the numbers of amino acid residues in various protein structures are of interest in relation to the idea that the manner in which the amino acid backbones polymerize to form the skeletons of native protein molecules may be characteristic for proteins as such (differentiating proteins from amino acid polycondensations which are not proteins) and that there may be a single skeletal type in all the individual chemical entities of proteins or a homologous series of types embodying some common constructional principle (*1*). For horse hemoglobin, ~580 residues are estimated (*2*), 6 with free α-amino groups (*3*); for horse (*2*) and whale (*4*) myoglobin, 146 and ~147 residues are suggested, one of each set having a free α-amino group (*3, 4*). For ribonuclease, a complement of 100 ± 10 is proposed (*5*); for the trigonal insulin structure (*6*), three substructures, each with ~102 residues (*7*) (4 with free α-amino groups [*8*]) are diagnosed (*9*).

From these figures there arises the possibility of a single type of skeleton in which about 48 residues are interlocked, with or without additional residues inserted by a single terminal and acting as substituents. (The fact that such a skeleton presents itself in the cyclol system [*10*] will be discussed elsewhere.) The ribonuclease structure would have 2 such units, the myoglobins 3, and insulin three sets of 2 such units. For horse hemoglobin (and probably also for the many other hemoglobins with about the same mol wt) the number would be 12.

Studying the idea of a characteristic skeleton or skeletons first in the form of the postulate of a single molecular skeleton for proteins in general, we see that the description of a protein structure would

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have 3 elements (*11*): (1) the number of the individual skeletons; (2) the arrangement in space of the skeletons—i.e., the molecular pattern of the structure; (3) specifications of the manner in which the various complements of R_1, R_2, . . . side chains are inserted into the sites of each skeleton. If this situation materializes, there may well be general principles regarding the sets of points with which the skeletons —and also water clusters—are associated (*11*). Molecular and water cluster patterns associated with points of cristobalite and tridymite networks, for example, would explain many facts regarding the space groups of crystalline proteins and the nature of various protein intergrowths (*12*). We also notice that a supposed difficulty (*2*) in the relation between, for example, the myoglobin and the hemoglobin of horse is resolved in this system of ideas. The myoglobin is, seemingly, not a precursor of the hemoglobin: how, then, can an apparent structural relation between them be explained? The difficulty disappears when we see that the myoglobin would have a certain system of skeletons characteristically substituted, and the hemoglobin the same set four times repeated, also characteristically but differently substituted.

In the light of these results, the time seems ripe for the application to intensity maps of protein crystals, as they become available, of certain of the techniques prepared for this purpose (*13*). It has been shown that a structure comprising a unit D repeated by translation at a set of points has the transform $T = T_\delta T_D$. In such a case we may make tentative assumptions regarding δ and D and construct new intensity maps entry by entry, the map $|T|^2/|T_D|^2$ when D is "given," the map $|T|^2/|T_\delta|^2$ when δ is "given." The transform of the first is, then, the vector map of the molecular pattern; the transform of the second is the vector map of the unit D. The transforms of a variety of structural types and of various kinds of molecular pattern, which have already been recorded (*13*), may prove useful in this connection. With the present viewpoint, the shapes of protein structures (such as the hemoglobin structure with mol wt $\sim$ 66,700) are functions of all three elements cited above. From these shapes the shape of the unit is not deducible. A possible starting point, however, is the assumption of a globulite type of skeleton, in which there is no gross difference in dimensions in various directions. The testing of this hypothesis from intensity maps of protein crystals is in progress.

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An Inhibitor of Desoxyribonuclease in Human White Blood Cells and Bone Marrow Cells and its Relationship to Cellular Maturity[1]

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Inhibitors of the enzyme desoxyribonuclease (DN-ase) have been reported. Zamenhof and Chargaff (*1*) have noted an inhibitor in yeast that is specific for yeast DN-ase. Laskowski *et al.* (*2*) have reported a similar, but not identical, inhibitor in the crop gland of the pigeon; and, in another communication (*3*), an inhibitor in various normal and cancerous tissues (human), as well as in the tissues of the normal rat, has been noted. No significant variations in the amount of inhibitor per gram weight of tissue were demonstrated. No studies have been reported on human blood or bone marrow cells, with the exception of one human marrow (*3*).

In the present work, the DN-ase inhibitor content of human white blood cells and bone marrow cells, both from normal subjects and from patients with leukemia, was determined. It was found that the inhibitor activity present in the cells varies with the degree of cellular immaturity. The inhibitor activity of mature human white blood cells averaged 37.4%/10^4 cells. The inhibitor activity of the primitive blast cells from acute leukemia was close to zero. Cells of intermediate degrees of maturity were found to have intermediate amounts of inhibitor.

A viscosity method was used for the determination of the enzyme inhibitor. The DN-ase activity was measured by the time required for the enzyme to reduce to one half the relative viscosity of a solution of desoxyribonucleic acid (DNA). The inhibitor activity of a given cell extract was measured by the amount of enzyme inactivated and is expressed as the percentage of the enzyme inactivated by the extract of 10^4 cells. Cell extracts of whole blood and of bone marrow were prepared by dilution (1/100) with water. The inhibitory activity of whole blood was found to reside solely in the white blood cells. Neither hemolyzed red cells nor plasma had appreciable inhibitor activity. The technique is to be described elsewhere (*4*).

The concentration of the desoxyribonuclease inhibitor in the various types of cell preparations is summarized in Table 1. The normal mature poly-

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