design of a better annealing schedule and, hence, more accurate structures.

Evidently the capacity of these Hamiltonians per residue is significantly larger than it is for Ising neural networks per spin (*2, 3*). The energies of the final annealed structures are sufficiently close to those obtained by annealing the x-ray structure of the target protein that rms values less than 3.0 Å are secured for most calculations. The number of protein families being small—of order 20 to 40 (*19*)—one has hope that a cunningly chosen database would have sufficient capacity to classify proteins into these families.

The Hamiltonian can also recognize variant sequences as demonstrated in the last entry of Table 1 and in Fig. 1C. The *Desulfovibrio vulgaris* rubredoxin differs from the *Clostridium pasteurianium* form included in the database at 50% of the residues. Of these, six are not synonymous in terms of our simple hydrophobicity scale. The 2.5 Å rms value demonstrates the Hamiltonian is able to generalize to this degree of substitutional mutation.

The large capacity of this simple associative memory Hamiltonian and its modest ability to generalize with respect to site mutations suggest that this approach offers a fruitful perspective on tertiary structure recognition. As it stands, the associative memory approach should be considered as a framework (as opposed to a method) for predicting structures. The recall of structure is, however, comparable or better than earlier studies that used only hydrophobicity statistics (*20*), which give rms values of 4 to 8 Å, although this is a somewhat unfair comparison. Further features must be incorporated in a fully predictive associative-memory Hamiltonian. Structures which have been modified by insertions and deletions must also be recognized. This requires a consideration of the invariances of Hamiltonians to these sequence transformations. The role of vector charges, many-body interactions, and modifications of the interaction network, such as dilution or changing the range of the potentials, are also of interest.

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21. We thank J. Bryngelson, H. Frauenfelder, J. Onuchic, K. Schulten, Z. Schulten, and J. Widom for helpful discussions, and D. Evensky and Z. Schulten for help with the graphics. Supported by NSF grant CHE 84-18619; the computations were done at the National Center for Supercomputer Applications, Urbana, Illinois.

9 June 1989; accepted 13 September 1989

Styles of Volcanism on Venus: New Arecibo High Resolution Radar Data

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Arecibo high-resolution (1.5 to 2 km) radar data of Venus for the area extending from Beta Regio to western Eisila Regio provide strong evidence that the mountains in Beta and Eisila Regiones and plains in and adjacent to Guinevere Planitia are of volcanic origin. Recognized styles of volcanism include large volcanic edifices on the Beta and Eisila rises related to regional structural trends, plains with multiple source vents and a mottled appearance due to the ponding of volcanic flows, and plains with bright features surrounded by extensive quasi-circular radar-dark halos. The high density of volcanic vents in the plains suggests that heat loss by abundant and widely distributed plains volcanism may be more significant than previously recognized. The low density of impact craters greater than 15 km in diameter in this region compared to the average density for the higher northern latitudes suggests that the plains have a younger age.

VOLCANISM IS ONE OF THE FUNDAmental processes of heat transfer from planetary interiors (*1*). The location of volcanic deposits and edifices, their volumes, and their sequence provide evidence for quantitative assessments of heat transfer in space and time. The nature of volcanic deposits provides clues to the style of volcanism, which is related to composition, volatile content, interaction with the crust during ascent, and the structure of the crust and lithosphere (*2*). New data for about 32 × 10^6 km^2 of the equatorial region of Venus (7% of the surface area of the planet) (Fig. 1) provide higher quality images than previously available for this region because of significant improvement in sensitivity and increased resolution by a factor of 5 to 10 for more than 50% of the region. They provide information about the nature of volcanic deposits and permit comparison to other parts of Venus previously imaged at both high and low resolution. These new data show that volcanism is an extremely widespread process in this part of Venus and that volcanic deposits cover most of the surface area and occur in a variety of environments and styles.

Observations of Venus were made during the summer of 1988 with the 12.6-cm wavelength Arecibo radar facility, and data were obtained with resolutions between 1.5 and 2 km. A circularly polarized signal was transmitted, and both senses of received circular polarization were recorded. The equatorial region was viewed at incidence angles from about 12° to 60° (the extremes encompass only a small fraction of the area, and the incidence angle for most of the coverage was between 20° and 50°, similar to the range expected for the Magellan mission), and the signal-to-noise ratio decreased with increasing incidence angle because of both the

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