such interactions may alter the stability of ordered conformations by special and quite different means.

In conclusion, and quite apart from considerations of mechanism, we wish to emphasize the empirical fact that certain neutral salts are very effective general macromolecular denaturants, and that others are rather potent general stabilizers of macromolecular conformations. We may note that highly concentrated solutions of salts of the latter type (K_2HPO_4, $(NH_4)_2SO_4$ and so forth) are often used to salt-out native proteins, and as the mother liquor for x-ray diffraction studies of proteins assumed to be native in the crystalline state.

PETER H. VON HIPPEL
KWOK-YING WONG
Department of Biochemistry, Dartmouth Medical School, Hanover, New Hampshire

References and Notes

1. H. A. Scheraga, in *The Proteins*, H. Neurath, Ed. (Academic Press, New York, ed. 2, 1963), p. 477.
2. K. H. Gustavson, *The Chemistry and Reactivity of Collagen* (Academic Press, New York, 1956).
3. J. Bello, H. C. A. Riese, J. R. Vinograd, *J. Phys. Chem.* **60**, 1299 (1956); D. C. Carpenter, *Cold Spring Harbor Symp. Quant. Biol.* **6**, 244 (1938).
4. P. Flory and R. R. Garrett, *J. Am. Chem. Soc.* **80**, 4836 (1958).
5. W. F. Harrington and P. H. von Hippel, *Advan. Protein Chem.* **16**, 1 (1961).
6. P. H. von Hippel and K.-Y. Wong, *Biochemistry* **1**, 664 (1962).
7. ———, *ibid.* **2**, 1387 (1963).
8. K. Hamaguchi and E. P. Geiduschek, *J. Am. Chem. Soc.* **84**, 1329 (1962).
9. W. F. Harrington and J. A. Schellman, *Compt. Rend. Trav. Lab. Carlsberg* **30**, 21 (1956); J. Hermans, Jr., and H. A. Scheraga, *J. Am. Chem. Soc.* **83**, 3283 (1961).
10. L. Mandelkern and D. E. Roberts, *J. Am. Chem. Soc.* **83**, 4292 (1961).
11. For most melting curves, crystalline (recrystallized five times) ribonuclease (salt-free, activity over 40 Kunitz units/mg), was used as obtained from Mann Research Laboratories, New York. Some experiments were also repeated with ribonuclease preparations obtained from Worthington, Freehold, N.J., and from Gallard-Schlesinger, Garden City, N.Y., as well as with samples of Mann chromatographically pure ribonuclease A. Essentially identical results were obtained with all preparations.
12. A report on the effects of various electrolytes and nonelectrolytes on the ribonuclease transition is in preparation.
13. J. G. Foss and J. A. Schellman, *J. Phys. Chem.* **63**, 2007 (1959).
14. J. P. Greenstein, *J. Biol. Chem.* **130**, 519 (1939).
15. Y. Tonomura, K. Sediya, K. Imamura, *ibid.* **237**, 3110 (1962).
16. The initial increase in T_m for DNA at low concentrations of salt can probably be largely attributed to the damping-out of electrostatic repulsions between adjacent negatively charged phosphate groups (*8*). The slight curvature of some of the ribonuclease data can probably also be attributed to electrostatic effects (*12*).
17. R. B. Simpson and W. Kauzmann, *J. Am. Chem. Soc.* **75**, 5139 (1953).
18. F. A. Long and W. F. McDevit, *Chem. Rev.* **51**, 119 (1952).
19. Supported by a research grant (AM-03412) and a career development award (GM-K3-5479) from the U.S. Public Health Service.

20 May 1964

Recent High Relative Sea Level Stand near Recife, Brazil

Abstract. *Radiocarbon dates for Vermetidae limestone from the edge of the Brazilian Shield at Cape San Agostinho, Brazil, indicate sea level stands of up to 2.60 meters above the present position, 3660, 2790, and 1190 years ago. Accurate determination of relative sea level is possible because of the well-defined habitat of the fossils dated.*

Shepard (*1*) has listed three current trends of thought about the rise of sea level during the last few thousand years: (i) during the past 6000 years, sea level has fluctuated between 1.5 m below and 3.0 m above its present position; (ii) sea level has been constant since it reached its present position some 3000 to 5000 years ago; and (iii) sea level has continued to rise slowly up to the present day. Shepard presents new information to support the last viewpoint. However, his graphs show considerable scatter of dates around the mean curve. The scatter exceeds several thousands of years for each position of sea level, or some 3 to 6 m for each point in time. Obviously, absolute sea level must have occupied a single position at each specific time. Consequently, one of the following alternatives must apply to each date to explain this scatter, provided that it is truly related to ancient sea level and not to an artifact (for example, a kitchen midden). (i) The date is in error because of faulty measurement or contamination with lighter or heavier carbon. (ii) The inferred relation to ancient sea level is incorrect. (iii) The area is unstable and either uplift or subsidence has occurred. (iv) The rise of sea level has indeed shown many fluctuations, some of them above present level, through all or many of the points given on the graphs (*2*).

Thus, there appears to be an urgent need for additional data that satisfy stringent requirements of purity of the sample, well-defined relation to ancient sea level, and stability of the region. In this report we present four dates obtained from measurements of biogenous limestone that encrusts parts of a small promontory of granite on Cape San Agostinho near the village of Gaibú, south of Recife, Brazil. The sample location is 34°56.0′ west longitude and 8°20.2′ south latitude (*3*). The area forms part of the eastern margin of the Brazilian Shield.

At Gaibú, the mean range for spring tides is 2.3 m with a maximum of 2.7 m, and the coast is exposed to a considerable swell. The following biological zonation occurs (Fig. 1): a *Littorina* zone in the upper part of the tidal range from 2.00 to 2.30 m above mean low water, corresponding to the "étage supralittoral" of Peres and Molinier (*4*); a *Chthamalus* zone in the middle upper part of the tidal zone from 1.40 to 2.00 m above mean low water, the upper part of the "étage médiolittoral" (the precise level of this zone varies, depending on exposure to the surf); a *Tetraclita* zone from 0.20 to 1.3 m above mean low water, corresponding to the lower part of the "étage médiolittoral"; a Vermetidae zone of thick concretions of encrusting gastropods, algae, and Foraminifera quite similar to those from the upper part of the "étage infralittoral" of the Mediterranean described by Molinier (*5*) [the dominant invertebrate in this zone, which is limited to a range from 0.30 to 0.80 m above mean low water, is *Petaloconchus* (*Macrophragma*), probably a variant of *P. varians* d'Orbigny (*6*)]; a *Sargassum* zone, infralittoral, extending below low water and including scarce coral heads.

Fossil Vermetidae limestone accretions attached under overhanging solid rock surfaces, or filling joints and cementing blocks, occur at various

Table 1. Radiocarbon dates of four samples of limestone from Gaibú, Brazil. (M.L.W., mean low water.)

Sample No.	Height above M.L.W. (m)	Height above top of living vermetidae zone (m)	Age (years)	Description
A-16	3.00	2.20	2790±150	Biogenous limestone with Vermetidae, Balanidae, and encrusting Foraminifera
A-17	2.40	1.60	1190±130	Biogenous limestone, mainly Vermetidae
A-21	2.20	1.40	1750±170	Biogenous limestone with Vermetidae and Bryozoa
A-22	3.40	2.60	3660±170	Biogenous limestone with Vermetidae

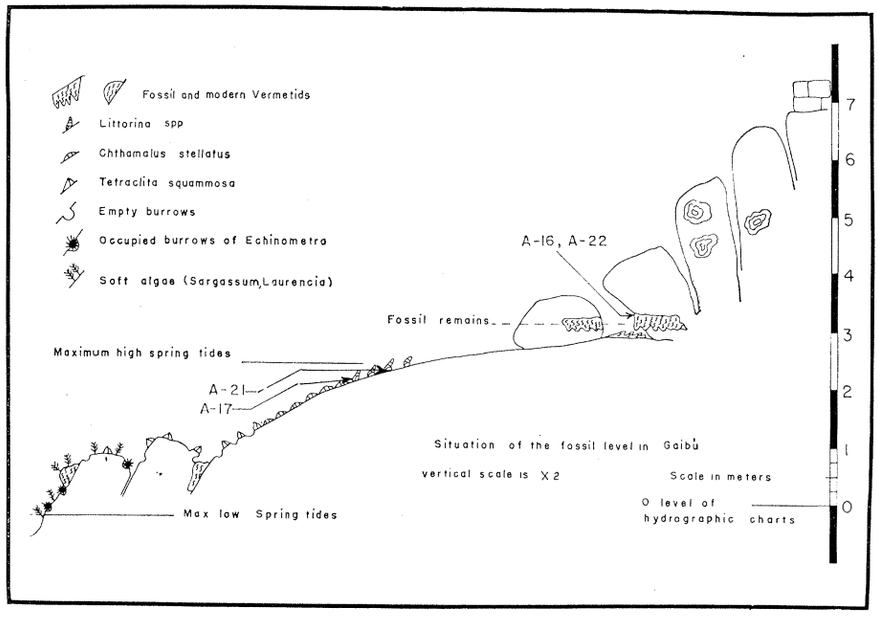

Fig. 1. The present ecological zonation and relative positions of dated samples on Gaibú promontory. Heights above mean low water (datum of Brasilian Hydrographic Charts) measured with Wild level.

levels above the zone of living invertebrates. The highest and most prominent fossil zone occurs approximately 3.40 m above mean low water, 0.90 m above the highest tides, and 2.60 m above the top of the living zone. The species composition of the fossil rock is identical to that of the living zone. Weathering of the surrounding granite locally has caused limestone blocks to protrude on 2-cm high inverted conical pillars.

Other evidence of a former higher sea level is presented by an abundance of empty burrows of *Echinometra* well above its present occurrence, by fossil *Tetraclita* limestone at approximately 2.60 to 3.00 m above mean low water, and by a cemented shell beach some 2.60 m above the present beach. In protected areas, both the living zone and all the fossil zones are approximately 0.30 to 0.60 m lower than on the open promontory.

Many years ago, Branner (*7*) and Hartt (*8*) discussed evidence for a former higher position of the relative sea level along the Brazilian coast. At several of their localities, one of us (J.L.) has observed numerous empty *Echinometra* burrows and the eroded heads of the relatively deep-living corals *Montastrea cavernosa* (L.) and *Mussismilia hartti* (Verrill) well above their present locations. A dissected reef of algae and Vermetidae was observed by Ottmann (*9*) on the Atoll das Rocas at the 3-m sea level. Thus, the observations at Cape San Agostinho are not unique.

Radiocarbon dates obtained for four samples of limestone (*10*) are listed in Table 1. The samples consisted of large blocks of limestone, and great care was taken to avoid contamination. The narrow, well-defined ecological position of the living Vermetidae zone allows, by reasonable extrapolation, a definition of sea level at the time of formation with an error of no more than 0.50 m. The maximum stand observed is 2.60 m.

We conclude that in this area, one, or possibly more, oscillations of sea level have taken place in the last few thousand years. The Brazilian Shield is very stable, as are all ancient shield areas. However, the dates obtained conflict with evidence from other parts of the world, notably the Gulf Coast (*11*), the Netherlands (*12*), and Florida (*13*), where there is no evidence for recent sea-level stands above the present.

Recent sea-level stands higher than the stand at present have been reported by Richards and Broecker (*14*) for Peru and for the Caribbean coast of Colombia. In both areas, uplift appears possible. Fairbridge (*2*) has amassed much evidence in favor of a complexly fluctuating sea level. Two of our dates (A-17 and A-21) coincide in age with Fairbridge's Rottnest submergence and with Tavernier and Moorman's (*15*) Dunkirk II and III transgressions, but are a little too high. A third falls within Fairbridge's Younger Peron Terrace (A-22). These correlations may be fortuitous and we do not wish to choose positions in the argument.

TJEERD H. VAN ANDEL
University of California, Scripps Institution of Oceanography, La Jolla
JACQUES LABOREL
Instituto de Oceanografia, Universidade do Recife, Recife (Pernambuco), Brazil

References and Notes

1. F. P. Shepard, *Science* **143**, 574 (1964).
2. R. W. Fairbridge, *Phys. Chem. Earth* **4**, 99 (1961).
3. The samples were collected on a visit by one of us (T.v.A.) at Recife during cruise 35 of the R. V. Chain of Woods Hole Oceanographic Institution in April 1963, Contribution of Scripps Institution of Oceanography, New Series.
4. J. M. Peres and R. Molinier, Commission internationale pour l'exploration scientifique de la mer Méditerranée. Colloque tenu par le Comité du Benthos, *Rec. Trav. Stat. Marine Endoume* **13**, 22 (1957).
5. R. Molinier, *Compt. Rend.* **240**, 361 (1955).
6. Determinations by courtesy of Myra Keen, Stanford University.
7. J. C. Branner, "The Stone Reefs of Brasil; Their Geological and Geographical Relations," *Bull. Museum Comp. Zool. Harvard Coll.* **44**, Geol. Ser. 7 (1904).
8. C. F. Hartt, *Geology and Physical Geography of Brasil* (Boston, 1870).
9. F. Ottmann, personal communication.
10. The radiocarbon analyses were carried out by the Shell Development Company, Houston, Texas, through courtesy of H. A. Bernard, whose assistance is gratefully acknowledged.
11. E. McFarlan, Jr., *Bull. Geol. Soc. Am.* **72**, 129 (1961).
12. S. Jelgersma, *Holocene Sea Level Changes in the Netherlands* (van Aelst, Maastricht, 1961).
13. D. W. Scholl, *Marine Geology*, in press.
14. H. G. Richards and W. Broecker, *Science* **141**, 1044 (1963).
15. R. Tavernier and F. Moorman, *Geol. Mijnbouw* **16**, 210 (1954).

1 May 1964

Superconducting Metastable Compounds

Abstract. *A number of metastable phases, germanides and tellurides of gold and silver, have been prepared, analyzed by x-ray diffraction, and investigated for superconductivity. The new superconductors and their transition temperatures are* $AgTe_3$ *(2.6°K),* Ag_5Ge *(0.85°K),* Au_5Te_3 *(1.62°K), and* $Au_{1-x}Ge_x$ *(0.99°K–1.63°K) where* $(0.27 \leq x \leq 0.60)$. *Au-Ge compositions with other values of* x *do not superconduct above 0.32°K.*

The question of the universality of the superconductivity phenomenon in metals has been a matter of considerable scientific interest and controversy in recent years. The phenomenon was originally thought to be a rare and uncommon occurrence in metals, requiring just the right combination of such factors as crystal structure and