can transfer, the fluorescence of the Y base is quenched on binding. Expectations are gratifyingly and conclusively borne out: the association constant is between two and three orders of magnitude higher for the binding of glutamate tRNA than for the codon trinucleotide. Moreover, when this effect is broken down into its enthalpic and entropic components, the difference is seen to lie in the entropy, which is actually marginally positive for the association of the tRNAs. The complex indeed is so stable that it can be seen in gel electrophoresis. It is reasonable to conclude then that the anticodon loop of tRNA is indeed conformationally locked, so as to present one strand of double helix to its codon, and further that to generate sufficient free energy of binding the codon in the messenger is also held in the same state on the ribosome.

GEODESY

Low Level Talks

from a Correspondent

It is well known, from both scientific and popular literature, that in many parts of the world coastlines are emerging from or sinking into the sea, and that these processes have existed since the Earth first acquired its oceans. The causes, nature and some of the consequences of the relative movement of land and sea in south-eastern England were discussed at the Royal Society on May 26 and 27.

Although the first day was devoted to the "evidence for land subsidence" it was quickly made clear that some of the evidence was not unambiguous. Professor K. C. Dunham (Institute of Geological Sciences, London) traced the geological history of the London basin and Weald; from a sea level of +30 m, towards the end of the Pleistocene, the land rose to form the flood plain terrace of the Thames. On the basis of carbon-14 dating this trend was reversed during the past 4,000 years. One major uncertainty was concerned with the rate of the rise of the sea level during the most recent geological times. The work of Dr Jelgersma in Holland was frequently quoted in discussion; she favours a decreasing (but continuing) rate of rise, but not all the speakers agreed. Dr R. G. West (University of Cambridge) contended that during the past 10,000 years there was no evidence for subsidence, but that all of a 45 m rise in sea level could be attributed to eustasy, that is, a global redistribution of the water from melting ice caps. Gravity measurements on land and in the Dover Strait and adjacent waters, together with an analysis of geological

faults, were shown by Dr E. R. Shephard-Thorn (Institute of Geological Sciences, London) to provide continuity from England to the continent.

Secular trends in sea level derived from tide gauge records during this century were presented by Dr J. R. Rossiter (Institute of Coastal Oceanography and Tides, Birkenhead); they clearly indicate that relative to Scotland, southern England is sinking at the rate of 15 cm per century, and the Thames area by 25 cm per century. A comparison of the Second and Third Geodetic Levellings put the north/south tilt much higher at 50 cm per century between Newlyn and Dunbar, but Brigadier J. Kelsey (Ordnance Survey, Southampton) found no evidence for a Newlyn/Thames tilt.

One of the most direct consequences of the rising sea level has been to increase the risk of catastrophic flooding in London by storm-augmented tides. Furthermore, as Dr A. J. Bowen (Institute of Coastal Oceanography and Tides, Birkenhead) pointed out, the tidal range at London is increasing significantly by more than 30 cm per century, caused by the embanking of the river and other artificial changes. A fascinating account of the current pro-

posals for the Thames barrier was given by Mr R. W. Horner (Greater London Council), which reflected the coordinated efforts of specialist working parties in the fields. The many and varied repercussions of a barrier, the engineering background of which was given by Mr A. M. Beckett (Sir Bruce White, Wolfe Barry and Partners), were discussed in detail. Not all the studies are yet completed, but the various compromises involving location, engineering design and construction, and operation seem capable of avoiding insurmountable problems.

A meeting at the Royal Society which commenced with the geological history of an area, and ended with detailed designs for a civil engineering structure having enjoyed, *en route*, a highly critical assessment by a sociologist (Miss A. V. Akeroyd, University of York) of the archaeological evidence for subsidence, clearly had something for everybody. Its principal achievement was to demonstrate that in the United Kingdom the scientific expertise exists, both in government institutions and university departments, to tackle effectively environmental problems of considerable economic and social significance, given the right kind of coordination.

Gravity Dissected

A NEW technique for exploring the Earth's gravitational field by analysis of satellite orbits has been successfully exploited by R. H. Gooding, who reports his work in Monday's *Nature Physical Science*. The Earth's gravitational potential is usually expressed as the sum of a series of harmonics defining the variations with latitude and longitude, and a detailed description of the field demands a large number of harmonic coefficients. The recent Smithsonian Standard Earth 1969 (*Smithsonian Astrophysical Observatory Special Report*, No. 315; 1970) has 296 coefficients, and the number increases as the square of the order of the highest-order coefficients, so that evaluating more and more coefficients would be very much a matter of brute force, possibly with unpleasant correlations to spoil the accuracy.

The need is for a fine probe which is responsive only to high-order harmonics: one such probe is the resonant satellite orbit, which follows the same set of ground tracks day after day. For example, a satellite in a polar orbit, which completes fourteen revolutions per sidereal day, that is, has an orbital period of 102.6 minutes, will follow a fixed set of fourteen ground tracks spaced at 25.7° in longitude. Such a satellite cuts the same swathes through the gravitational field day after day,

and the fourteenth-order components in the field will cause progressively increasing along-track perturbations in the satellite's motion. Stable resonant orbits of order 9, 12, 13 and 14 have already been most useful in studying the gravitational field.

Resonant orbits of order 15 have not hitherto been used, because they are so low (height 500 km or lower) that they are seriously affected by air drag, which quickly destroys an exact resonance. The new technique introduced by Gooding is to choose a satellite which passes slowly through the fifteenth-order resonance under the action of air drag, and then to analyse the resulting change in the inclination of the orbit to the equator, which depends on the value of fifteenth-order harmonics. Gooding determined the definitive orbit of the Anglo-US satellite Ariel 3 for the benefit of the experimenters, and he found an unexplained decrease in inclination of about 0.02° during the first three months of 1968. He has now analysed these results in detail, to obtain what are likely to be the best values yet for a set of lumped fifteenth-order harmonics. His work points the way towards similar analyses of satellites at other inclinations, allowing the determination of sets of harmonics of degree 15 and higher, uncontaminated by the effects of other harmonics.