the electron self-mass arises from the interaction of its electromagnetic and gravitational properties to produce the electron radius.

To a cosmologist, the most exciting implication of this work (as yet unpublished) is that the gravitational force may be repulsive over very short distances. The agreement of the predictions of this theory with those of Hoyle and Narlikar, who have approached the problem from the gravitational end rather than starting from conventional particle physics, makes both theories more attractive and their implications correspondingly more interesting. The whole question of gravitational collapse (or the lack of gravitational collapse) and the significance of this for cosmology and cosmogony seem once again to have prime importance.

CARBONYL COMPOUNDS

More Small Rings

from our Organic Chemistry Correspondent

THREE-MEMBERED ring carbonyl compounds have frequently been postulated as intermediates in organic reactions. Perhaps the best known example is the intermediacy of α -lactones in solvolysis reactions of α -halocarboxylic acids. Recent attempts to isolate compounds of this type have been successful in the case of the carbocyclic cyclopropanones and with the nitrogen containing α -lactams, but all efforts to obtain an example of the analogous oxygen system, that is, an α -lactone, have been unsuccessful.

The recent report that the lactone (I) of di-*t*-butyl glycolic acid is stable in solution at -80°C fills this gap in the literature of small-ring compounds (Wheland and Bartlett, *J. Amer. Chem. Soc.*, **92**, 6057; 1970). As with several other small-ring carbonyl compounds, the relatively high stability of (I) is dependent on the shielding effect of the bulky *t*-butyl substituents. Synthesis of the α -lactone was accomplished by oxidizing di-*t*-butylketene with ozone, a reagent known to epoxidize highly hindered olefins. In spite of the effect of the *t*-butyl groups, the α -lactone is no longer stable when the solution (in 'Freon 11') is warmed to -20°C ; a white precipitate of polyester $[(\text{C}_9\text{H}_{18}\text{CO}_2)_n]$ separates, the formation of which is probably initiated by equilibrium formation of the zwitterion (II). Molecular orbital calculations indicate that the two structures [(I) and (II)] have similar energies, though spectroscopic evidence clearly rules in favour of (I) as the structure of the species in solution at -80°C .

The reactions of (I) are in accord with the character ascribed to α -lactone intermediates in the solvolysis reactions already mentioned, and polymer formation parallels observations on reactions of some peroxides in which α -lactones are also believed to mediate.

Attempts to prepare the diphenyl analogue of (I) from diphenylketene were attended by polymer formation $[(\text{Ph}_2\text{CCO}_2)_n]$ even at -80°C . Presumably, the phenyl substituents tend to stabilize the zwitterionic structure relative to the covalent α -lactone, but a monomeric species was trapped by carrying out the

oxidation of diphenylketene in the presence of methanol, when the product was α -methoxydiphenylacetic acid.

SEA FLOOR SPREADING

Geochemical Effects

from our Geomagnetism Correspondent

SINCE—and even before—sea floor spreading became widely accepted, there have been many attempts to relate geophysical and geochemical parameters to the distance from spreading oceanic ridges. The variation of one such property, the chemistry of the principal elements of basalts, was first reported by McBirney and Gass (*Earth Planet. Sci. Lett.*, **2**, 265; 1967), who showed that the silica saturation of basalts decreases with distance from the ridges and correlates with the decrease in heat flow. To be sure, this was not the first time that differences had been observed between ridge and non-ridge basalts; geochemists have known for some time that ridge basalts tend to be tholeiitic whereas alkali basalts are more likely to be found away from ridges. But McBirney and Gass demonstrated for the first time that variations with distance were systematic.

But do the major elements in basalts always vary with distance from the ridges? And if so, why? To answer these questions, Hart (*Earth Planet. Sci. Lett.*, **9**, 269; 1970) examined the analyses of 112 deep ocean basalts and found that the major elements do usually vary in this way. Thus, for oceanic basalts up to about 18 million years old (the limit of Hart's data), silica, calcium and magnesium decrease almost linearly with distance from the ridges, whereas potassium, iron, titanium, sodium, manganese and phosphorus increase, also approximately linearly. In addition, ferric iron replaces ferrous iron; but aluminium apparently does not change.

Several possible reasons for these variations come to mind. They could arise, for example, from progressive changes in the composition of the magma as it is extruded at the ridge crests. That such changes would be so systematic during a period of 18 million years at least is unlikely, though not impossible. Another possibility is that the basalts have been altered since they were laid down. In view of what amounts to a correlation of major element chemistry with age, this looks like a natural explanation, though deuteric alteration cannot be ruled out *a priori*.

Hart suggests that the variations are produced by alteration through weathering—a hypothesis to which he brings convincing evidence from studies of the weathering of single pillow basalts. In this context, of course, weathering means chemical exchange between the basalts and sea water, though there is still some doubt about whether pillow weathering truly results from subsequent hydration or whether it is deuteric. Insofar as the alteration in pillows is zoned, with the most heavily altered zone on the outside, Hart supports the view that pillows are chemically changed by the water. He then proceeds to compare the changes in the principal elements with those of the deep ocean basalts. The trends are very similar.

If the changes in oceanic basalts really result from long term hydration, geochemists must in future distinguish carefully between true alkali basalts and tholeiitic ridge basalts which have been weathered to