molecular weights 100,000 and 18,000 was presented by L. Routledge (University of Cambridge).

The focus of biochemical interest is still the mechanisms of sclerotisation (cross-linking) in the insect cuticle, a subject bedevilled by much misguided and inconclusive research. P. C. J. Brunet (University of Oxford) pointed out that we really know little more now than we did after Pryor published his first observations on the sclerotisation of the cockroach ootheca in 1940. Brunet's message was, essentially, go back to Pryor's work and start again! S. O. Andersen (University of Copenhagen), echoing one of Pryor's ideas, proposed that the sclerotising quinones form bulky complexes in a manner very similar to lignification in plants. The novelty of his model is that the hydroxyls of one aromatic ring link across a carbon-carbon double bond in the side chain of another aromatic ring. He is now chasing the enzyme responsible. A quantum jump in the investigation of sclerotisation which avoids the difficulties inherent in destructive biochemistry has been made by R. N. Pau (ARC Unit of Invertebrate Chemistry and Physiology, University of Sussex), who has started looking at cross-linking *in situ* using NMR techniques. He can follow the course of sclerotisation in the cockroach ootheca and detect changes in bonding of the sclerotising phenols and in specific amino acids of the protein. His preliminary results show great promise in analysing the reactions as thy occur.

However, despite the fact that biophysicists and biochemists are taking cuticle apart they cannot yet say how the components interact to form a multipurpose exoskeleton. S. E. Reynolds (University of Bath) described the effects of eclosion hormone and bursicon on cuticle mechanics, but no-one could explain what happens within the cuticle to produce these effects. We need to know more about the mechanics of cuticle and their biochemical basis. That such results could have practical implications is shown by the success of Dimilin. □

# Alpha-particle clustering in light nuclei

*from P. E. Hodgson*

ONE of the most interesting questions about nuclear structure is the extent to which the nucleons tend to group together in clusters, particularly α-particle clusters, as these are the most probable because of their high symmetry and stability. It is conjectured that these clusters are continually forming and reforming inside the nucleus as the nucleons interact with each other. This simple classical picture must be expressed quantum-mechanically in terms of the probability of the overlap of the wavefunctions of the four constituent nucleons, two protons and two neutrons. There is then always a small overlap even when classically we would say that there is no α-clustering, so we must ask whether there is α-clustering over and above that given trivially by a particular model of nuclear structure.

The most direct way of studying α-clustering in nuclei is by reactions that knock an α-particle out of the nucleus, or that pull it out in some other way. Among the knockout reactions (p, pα) and (α, 2α) are the most frequently used, and in addition there are many transfer reactions such as (d, $^6$Li), ($^3$He, $^7$Be) and ($^{16}$O, $^{20}$Ne) that remove an α-particle from the nucleus. Calculations of the cross sections of such reactions can be made using standard nuclear theories, and comparison with the experimental data shows whether there is any excess cross section that could be attributed to α-clustering, since this would automatically increase the likelihood of such reactions.

Some studies of α-clustering have recently been made in this way by Chant, Roos and Wang (*Phys. Rev.* **C17**, 8; 1978) using the (α, 2α) reaction at 140 MeV on several light nuclei. They found a large enhancement of the cross sections that strongly indicates the presence of α-clustering.

In the calculation of the (α, 2α) cross section, it is necessary to represent the knocked-out α-particle by a wavefunction that is obtained as the eigenstate of a particle in a potential well. The parameters of this potential are chosen to give the known α-particle separation energy and distribution of nucleons in the nucleus, and the quantum numbers of the α-particle state are chosen to conserve the number of harmonic oscillator quanta. A calculation made in this way gave a cross section for the $^{16}$O(α, 2α) $^{12}$C(GS) reaction that was about 200 times smaller than that observed experimentally.

The form of the α-nucleus potential was obtained by folding the known α-nucleon potential with the density distribution of $^{12}$C, and this gives a wavefunction with a root mean square (RMS) radius of 3.03 fm, which is somewhat larger than the measured $^{16}$O RMS radius of 2.65 fm. Nevertheless, the calculated spectroscopic factor (a number measuring the quantum-mechanical overlap between the $^{16}$O wavefunction and the product of the $^{12}$C and α-particle wavefunctions) is 0.23, compared with a value of 40.3 obtained from the experimental data. To obtain such a value, it is necessary to increase the radius parameter of the potential from $1.09 \times 12^{1/3}$ to $2.52 \times 12^{1/3}$ fm, corresponding to a RMS radius of 4.37 fm. This α-particle wavefunction peaks very far out in the nuclear surface, indicating the importance of α-clustering for such reactions.

The α-clustering indicated by this work could either be already present in the target nucleus before the interaction, or it could be produced by the interaction. This latter possibility could arise if there is a strong coupling between the entrance channel and one or more excited states with large probabilities for decay by α emission. Coupled channels calculations of this type of process would be of great interest. □

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## A hundred years ago

THE GOVERNMENT of Uruguay intends to construct a railway which will unite Uruguay with the Province of Rio Grande do Sul, in which many thousands of colonists are settled. The line is to begin on the right bank of the Quarahim River, and is to extend as far as the town of Uruguayana. On the Quarahim River this railway will join the line in course of construction between Slato and Santa Rosa, which is already finished and in use as far as Jacuhi (some 300 miles), and which in turn corresponds with the line between Salto and Fray Bentos, where the great Salderos (slaughter-houses) of the 'Liebig Company' are situated at which over 1,000 head of cattle are killed daily to make the well-known 'Liebig Extract of Meat'.

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