for this purpose. The results showed that all pass and honours students obtained at least 40 per cent in classes 1, 2 and 3, whereas none of the failed students scored more than 40 per cent in these classes. Thus there was no difference in the result—so far as pass and fail were concerned—using this assessment based on the classification as compared with the overall percentage method. There was, however, a considerable difference in the number of honours

grades awarded, for different taxonomic gradings, one of which is as follows:

	Honours	Pass	Fail
Overall percentage grading	25	93	32
Taxonomic grading	40	78	32

The conclusion appears to be that considerable care is needed, particularly at the upper end of the scale, if examining is to provide an accurate assessment of what is sought from students.

SALARIES OF UNIVERSITY TEACHING STAFFS IN BRITAIN

IN a written answer in the House of Commons on March 14, the Chief Secretary to the Treasury, Mr. H. Brooke, stated that the Government had considered the recommendations of the University Grants Committee for recurrent grants for the five-year period 1962–67. It had also considered substantial increases in the salaries of university teaching staffs with the determination to effect the most rapid development of higher education that is consistent with other claims on the nation's prospective economic resources in the next five years and with the Government's policy for incomes. These considerations had made it necessary to depart from the Committee's recommendations and he had informed the Committee that, subject to annual approval of the Estimates by Parliament in the normal way, it should plan on the basis of the following recurrent grants from August 1 next: 1962–63 £56 million; 1963–64, £60.5 million; 1964–65, £65.5 million; 1965–66, £70.5 million; 1966–67, £76.5 million. The grant for the present university year is £49.5 million. These figures exclude provision for rates, which will be financed by special grants outside the quinquennial settlement, and the cost for the universities of the Government's recent request for an increase in the intake of medical students had yet to be finally settled and would also be additional to these figures.

Mr. Brooke reaffirmed the undertakings given last year on the rapidly increasing provision for non-recurrent grants and added that the awards to university students from public funds was also continually growing. In sum, the aggregate cost of the universities to public funds had increased from £50 million to £104 million during the past five years and might increase by at least £50 million in the next five years.

The universities' estimates, including those of the seven new universities authorized during the present quinquennium, indicated that, given adequate financial support, they would be prepared to work to an expansion of the total student population from about 111,000 in 1961–62 to about 150,000 in 1966–67. Mr. Brooke had asked the University Grants Committee to inform the universities that it was the Government's wish that the additional funds should be applied so far as possible to achieving the figure of 150,000. The Government's aim was to continue the expansion to about 170,000 places by 1973–74. These recurrent grant figures are based on rates of academic salaries which came into effect in January 1960. The Government had taken carefully into account the strong arguments advanced by the University Grants Committee for a substantial increase in these salaries, along with the need to expand the teaching staff in relation to the increase in student numbers, but did not feel able to authorize an increase of more than 3 per cent in the bill for academic salaries. Scales based on an aggregate increase of this order would be authorized from April 1, 1962, and would cost about £1 million extra in the first full year. The scales would be reviewed afresh next year. Provision for university expansion was only part of the resources that the Government was devoting, on an increasing scale, to higher education; and all these programmes might need to be re-examined in two or three years' time in the light of the report of the Robbins' Committee on Higher Education. The Government's proposals for the first year of the new quinquennium and for the increase in salaries would necessitate a supplementary estimate of some £4.5 million for 1962–63.

RHEOLOGY OF CLAY SOILS

AT the meeting of the Cambridge Rheology Club held on February 5, Mr. W. J. Thompson (Department of Engineering, University of Cambridge) spoke on the "Rheology of Clay Soils". He pointed out that it is current practice in soil mechanics to use the triaxial apparatus to study the shear characteristics of a soil. In this apparatus a cylindrical sample of soil can be subjected to any desired combination of axial and hydrostatic stresses, the sample being either allowed to drain during the deformation process (drained test) or be maintained at a constant volume (undrained test). The allowable shear strength value used in soil mechanics com-

putations is taken as some proportion of the maximum shear stress τ_m obtained in a constant axial strain-rate triaxial test, although corresponding tests with constant axial stress have indicated that for stresses $> 0.8 \tau_m$ a state of structural disintegration is obtained. Consideration should therefore be given only to the region of the stress-range ($< 0.8 \tau_m$) within which the soil would behave in the field. Present shear theories are generally based on the results of constant strain-rate tests and neglect time considerations.

The existence of a yield-point in the shear deformation of clays, as investigated by Bingham and Scott

Blair, is not generally accepted. Tests by Gueze and Tan with a torsion plastometer, and by Haefeli, have indicated the existence of yield-point and at higher stresses a pronounced tendency for the development of a state of structural disintegration as in triaxial tests. It is considered by several workers that the apparent yield-point is due to measurement inaccuracies and that the true flow-curve is of the thinning thixotropic form observed by Ostwald. Experimental evidence appears to confirm the conclusion reached by Reiner that volume deformation is generally a combination of elastic, viscous and plastic processes. The rate of the water expulsion occurring with volume decrease in saturated soils is governed by Darcy's law.

The large strain behaviour associated with shear-failure may be considered as of an essentially plastic nature, this being generally assumed in the determination of allowable footing loads which correspond to much smaller strains. Simple viscoelastic models are proposed for small strain volume change and shear deformation caused by stresses $< 0.8 \tau_m$, based on available experimental evidence. On the assumption of isotropy, these models can be combined for any stress and strain conditions. The predicted behaviour for one-dimensional compression, in which

a laterally confined cylindrical sample is subjected to a uniform axial stress, is in reasonable, but not exact, agreement with the observed data. The generally used analysis of one-dimensional compression data is based on the assumption that the structure of the clay particle behaves as an isotropic elastic material for any given increment of load. The inclusion of anisotropic considerations is of excessive mathematical complexity.

The study of the rheology of clay soils is still at a preliminary stage, and much detailed experimental work remains to be done before further progress can be made. The use of apparatus enabling precise measurement of the imposed conditions is essential.

The next meeting of the Club will be held at the Technological Research Station, Spillers, Ltd., Station Road, Cambridge, on May 7, when Mr. R. G. King (Farol Research Engineers) will speak on "Viscoelasticity and the Weissenberg Rheogoniometer". The instrument will be available for the two days following the meeting for practical demonstrations on materials which members of the Club or visitors are invited to submit. Notice of this should be given in advance to the Secretary of the Club at the above address.

H. G. MULLER

PHENOLIC ALKALOIDS

A SYMPOSIUM organized by the Plant Phenolics Group was held at the School of Pharmacy, University of London, on January 9, and was concerned with the alkaloids of the opium poppy and of *ipecacuanha*.

Under the chairmanship of Prof. W. O. James a paper on the distribution and significance of alkaloids in *Papaver somniferum* was presented by Prof. J. W. Fairbairn (School of Pharmacy, University of London). The work in his laboratory was chiefly a study of the occurrence of alkaloids in relation to the origin and distribution of laticiferous vessels and an analysis of the latex composition using samples drawn at short intervals from unripe capsules. It was confirmed that alkaloids were restricted to laticiferous vessels and also shown that this anastomosing system always occurred in the phloem, but was absent from stamens, ovules, seeds and seedlings up to the cotyledon stage. Latex from capsules had been assayed for morphine, caoutchouc and total solids, and it was shown that rapid changes in the composition of the latex took place in short periods of time such as 2 hr. Similar rapid changes had also been shown to take place in the fruit of *Conium maculatum* (Fairbairn and Suwal). From anatomical and qualitative chemical results it had been suggested that the alkaloids might be products of photosynthesis, secreted into the laticifers and so removed from metabolic circulation. This 'drain-pipe' theory now appeared unlikely owing to the rapid alkaloidal variation, and further work might raise the status of the latex from that of a slowly growing heap of 'metabolic sewage' to that of a living entity, actively participating in the metabolism of the plant.

Biosynthesis of Opium Alkaloids. An account of the studies which have been carried out in several laboratories was given by Dr. A. R. Battersby (University of Bristol), who was responsible for recent work at Bristol involving the feeding of growing

plants with tyrosine, labelled specifically with carbon-14. Unambiguous degradation of carefully purified alkaloids, isolated from the plant, had shown that the molecule of papaverine was specifically labelled at positions 1 and 3 and morphine at the corresponding positions 9 and 16. These results were interpreted as showing that two aromatic units with a two-carbon side-chain (*Ar-C-C*) constitute building blocks in the carbon(16) skeleton of the alkaloids studied. Supporting evidence was available by synthesis of norlaudanosoline specifically labelled with carbon-14, which was incorporated into papaverine and morphine by feeding experiments. Furthermore, results of controlled degradation of the latter radioactive alkaloids showed little doubt that the rings *A* and *C* of morphine are joined by a phenolic coupling reaction between two aromatic rings. Rate studies on the incorporation of activity into the two alkaloids from carbon-14 carbon dioxide (Rapoport *et al.*) and from specifically labelled tyrosine (Bristol workers), together with other evidence, had shown that the alkaloids are formed in the order thebaine-codeine-morphine. Concluding his account of recent work, Dr. Battersby was able to show that the present evidence was in keeping with the view that the opium alkaloids are products of the shikimic-prephenic acid pathway, the two *Ar-C-C* units produced by this route being used to provide the sixteen carbon atoms required for skeletons of the bases. It was probable that the units were different, yet derivable from tyrosine in the living plant.

Chemical Structure and Pharmacological Activity. In the afternoon session Prof. W. B. Whalley (School of Pharmacy, University of London) introduced Dr. N. J. Harper (Chelsea College of Science and Technology), who discussed the relationships between structure and pharmacological activity of morphine and related substances. He stated that morphine had been modified chemically in many ways in