Of the 2 years of compulsory pre-registration appointments, the second year need not be one of residence in hospital, and, for many students, part of it should be spent in general practice, approved for the purpose and working from a health centre.

The aim should be to increase the intake of medical students to 3,500 a year as quickly as possible. Pre-clinical schools could be expanded to an intake of up to 200, but clinical schools should not normally have an intake of more than 100. Thus, more clinical schools would be required, and at present there are suitable hospitals in some of our provincial cities with medical schools which could be adapted as second clinical schools without great expense, and would share the university departments. The number of pre-clinical schools in London could thus be reduced.

In teaching hospitals the distinction between general medical and surgical wards should be abolished, but the teams in charge would comprise both physicians and surgeons, and the leaders of the teams might belong to either discipline.

In postgraduate training the increase in the organized teaching in district hospitals is welcome, and will need further expansion if a second pre-registration year is introduced. In London another look should be taken at the grouping of the special hospitals and institutes and some of them might be associated with or even incorporated in general hospitals.

For the better organization of postgraduate training of overseas doctors, an increase in the contacts with these countries and their medical schools is desirable, and regional boards might play a part in this.

SYMMETRY PRINCIPLES AT HIGH ENERGY

IN so rapidly developing a subject as elementary particle physics frequent conferences play an important part in the exchange of knowledge. The doyen of such meetings is the 'Rochester' Conference, affectionately called after its place of origin even though to-day its meetings are as likely to be held in Geneva or Dubna. It is a gathering of several hundred theorists and experimenters, and when it comes together every two years its sessions are concerned with all aspects of the subject. A necessary complement to so large and infrequent an assembly is the holding of regular small conferences on specific topics. The Coral Gables Conferences on Symmetry Principles, organized by the Center for Theoretical Studies of the University of Miami, have come to occupy an honourable place among such meetings.

The first two Conferences were held during a hectic and euphoric time for the practitioners of symmetry principles: the rapid discovery by experimentalists of more and more particles was matched by the invention by theorists of higher and higher symmetries with more extensive multiplets in which to locate them. Such boom conditions could not last for ever and if the atmosphere at the third Conference in January 1966 was less feverish this simply reflected a return to normal after the heady days of the immediate past. There were, nevertheless, many contributions of sober interest.

One of the most powerful techniques in symmetry physics has been the use of the current algebras invented several years ago by Gell-Mann and exploited by him to give many results in agreement with experiment. The method takes as its basic assumption the equal-time commutation relations of the integrated components of certain currents associated with weak, electromagnetic, and (by means of another assumption called the partially conserved axial current) strong interactions. During the past year Fubini and Furlan devised an important way of using dispersion theory in these calculations and this was employed by Adler and Weisberger to calculate the ratio of the Fermi coupling to Gamow–Teller coupling in β-decay, in excellent agreement with experiment. However, a useful assumption in many calculations, namely, that the commutation relations are saturated by a small number of neighbouring states, encountered certain theoretical difficulties which were pointed out by Coleman. In his address to the Conference, Gell-Mann explained how these difficulties could be avoided by working with matrix elements of states corresponding to infinite momentum and using only that sub-algebra of currents which has finite matrix elements to states of finite mass in this limit. It is known that the octet and decimet baryons of $SU(3)$ do not saturate these relations. Gell-Mann and Dashen are engaged on a calculation using various low-energy experimentally determined parameters as the input by which they hope to determine what further states are needed for saturation and so to arrive at a prediction of the nature of the higher-lying baryon resonances.

The current algebra technique does not commit its users to the belief that the algebra involved is a symmetry of the Hamiltonian applying to the whole of physics. It is only necessarily relevant for the matrix elements of the particular currents involved. Current algebras are thus essentially statements about the dynamical workings of the theory rather than about general invariance requirements. The relation between broken symmetries and dynamics is one that is little understood. Many people believe that the answer lies in a bootstrap theory which pictures elementary particles as all being bound states of each other, held together by forces due to the exchange of the particles themselves. In this way no particle is more elementary than any other and they can all be regarded as being composite. Simple models suggest that such theories might lead to symmetries, and Capps presented a contribution at the Conference on this question. However, realistic dynamical calculations are extremely difficult, not least because of a lack of understanding of the effect of multiparticle states on the structure of the theory.

The second Coral Gables Conference had heralded the entry of non-compact groups into elementary particle physics by the construction of relativistic versions of $SU(6)$. The unitary representations of these groups, which are needed in quantum mechanics, are infinite-dimensional and considerable ingenuity was expended in breaking the symmetry in elegant ways so that finite multiplets corresponding to sets of elementary particles could be obtained. However, ever since hole theory, elementary particle physicists have enjoyed making a virtue of vice, so that increasing numbers of people have thought that the presumably infinite sets of all elementary bosons and fermions, discovered and yet to come, might correspond to two or more infinite-dimensional representations of a non-compact group. This idea of killing infinitely many birds with one stone gained some encouragement from the fact which had long been known that the bound states of the hydrogen atom correspond to a single representation of $O(4,1)$. Fronsdal and Rühl gave details of some investigations they had made along these lines. Some initial difficulties in the satisfactory coupling of representations have been overcome and an unexpected feature is that the Born approximation already gives non-trivial momentum-dependent form factors. Another worker in this field is Salam, and his absence from the Conference owing to illness was much regretted both for

this reason and for the fact that his enthusiasm for symmetry physics is one of the expected pleasures of such occasions.

Non-compact groups are the mathematically opulent approach to elementary particles. A more mathematically economical, if physically rather opaque, line of attack is afforded by the use of quark models. Indeed, so economical is this latter approach that it has been noticeably successful in getting many of the $SU(6)$ results without actually assuming $SU(6)$. An investigation of this was reported by Lipkin. Characteristically he finds an interesting new sub-group as the cause.

An elusive particle (if it exists at all) is the magnetic monopole suggested by Dirac in 1931. As he pointed out, it is theoretically desirable since it leads to the otherwise unexplained quantization of electric charge. Schwinger gave a new account of the theory which leads to a different, more restrictive, quantization condition.

The final arbiters of all symmetry schemes are the experimentalists, whose findings can sometimes confirm and often destroy a theoretically elegant possibility. Excellent surveys of the present situation were given by Samios and Frisch. However, occasionally the theorists can get their revenge. Another experimentalist gave a talk on an experiment which he was planning, but a very quick-witted theorist pointed out in a spontaneous comment that the effect sought was identical with, and thus not capable of being disentangled from, another interaction also present. As someone else pointed out, the saving as a result of this observation more than paid for the whole Conference.

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EARTHING OF ELECTRICAL SYSTEMS

THE safety and integrity of electrical power supply systems are almost universally dependent on some form of earthing which aims at limiting, under fault conditions, the potential difference between the general body of earth and certain parts of the system. The British Standards Institution has recently published a Code of Practice (*CP* 1013: 1965—*Earthing*) dealing with the subject*.

System earthing, as distinct from the earthing of electrical apparatus, began in the 1890's when the supply was utilized almost wholly for lighting and the need for equipment earthing on consumers' premises was relatively slight. Practice in the matter of earthing consumers' installations developed relatively slowly. While there is no mention of earthing in the first edition of the Institution of Electrical Engineer's *Wiring Regulations* issued in 1885, the third edition of 1897 recommends the earthing of the frames of dynamos and motors and of transformers. The eighth edition published in 1924 contains a substantial section dealing with consumers' installations and mentioning the provision of earth terminals.

Although the safety of electrical installations is a subject which has received much attention in recent years, it is probably not generally sufficiently realized that satisfactory protection by means of simple earthing, together with fuses or circuit breakers, becomes progressively more difficult of achievement as the load taken by the consumer increases.

While, in general, the question of how an electrical system shall be earthed is governed by legislation, the regulations are so worded as to permit any type of earthing provided that it is as safe as is practicable and that it is unlikely to interfere with telecommunication.

The new code of practice deals comprehensively with general considerations and with specific practices relating to the earthing of supply systems and of consumers' installations. There are six main sections, two of which, entitled "General" and "Design Considerations", deal with principles and practice concerning power stations, transmission and distribution systems, consumers' premises, traction and lightning protection. Sections 3, 4 and 5 deal respectively with the temporary safety earthing of high-voltage apparatus or mains, inspection and testing and maintenance. Section 6, which completes the work and is entitled "Miscellaneous", is concerned mainly with a number of specific legislative provisions.

Opening with a statement of scope, followed by a list of definitions, the subject is developed clearly and concisely and with an adequate amount of explanatory material. The Code constitutes an admirably comprehensive guide to earthing practice which will be a work of day-to-day reference for supply engineers, electrical contractors, maintenance engineers and, indeed, for all who have responsibility for electrical installations.

JAMES GREIG

* The Council for Codes of Practice, British Standards Institution. British Standard Code of Practice, *CP* 1013: 1965—*Earthing*. Pp. 129. (London: British Standards Institution.) 30*s*. net.

VOLCANOLOGY RESEARCH IN NEW ZEALAND

IN 1963, the Royal Society of New Zealand and the New Zealand Geological Survey (Department of Scientific and Industrial Research) invited the International Association of Volcanology to hold its 1965 symposium in New Zealand, to mark the centenary of the New Zealand Geological Survey. This symposium, held during November 22–December 3 at Auckland, Rotorua, Taupo and Wellington, was attended by more than one hundred delegates from twenty-three countries. The two main subjects were acid volcanism (including ignimbrites) and geothermal resources.

The problem of the genesis of acid volcanic rocks is particularly acute in an area such as the central volcanic zone of the North Island of New Zealand, where the volume of these highly silicic rocks greatly exceeds that of basic and intermediate types, and where individual eruptive units of acid rock are of such enormous volume. The problem hinges on whether this acid magma was produced by the large-scale fusion of crustal material or is a fractionation product of basic magma, itself generated originally within the upper mantle. A further possibility is that the acid magma may even come directly from the mantle.

In New Zealand, the basement which is believed to underlie the volcanic rocks includes a great thickness of Mesozoic to Tertiary greywackes. The chemical composition of these greywackes is such that their partial fusion could produce a melt similar in composition to the observed acid volcanic rocks. This origin is at present favoured by New Zealand geologists; basic and intermediate volcanic material is not sufficiently abundant to be quantitatively acceptable as a parental magma. Geochemical studies which have a bearing on this problem were discussed