graphically[3]. Of these, the first three have also been analysed chemically[4]. Phosphor-bronze (containing elements of high atomic weights) and lucite (containing elements of low atomic weights) are included for comparison in the discussion of mean and effective atomic weight.

The computed values of mean and effective atomic weights of all specimens are shown in Table 1.

Table 1. MEAN AND EFFECTIVE ATOMIC WEIGHTS

Specimen	Petrographic analysis		Chemical analysis	
	A_{mean}	A_{eff}	A_{mean}	A_{eff}
Limestone	24·82	20·12	24·87	19·80
Magnetite	41·25	30·21	34·75	26·21
Syenite phorphory	27·50	21·06	21·57	20·20
Anhydrite	26·81	22·62	—	—
Serpentine	24·65	18·55	—	—
Rhyolite	28·04	20·79	—	—
Phosphor-bronze*	—	—	66·06	64·72
Lucite*	—	—	12·40	6·67

* Phosphor-bronze (copper, 94·8; tin, 4·8; phosphorus, 0·4); lucite (carbon, 59·98; oxygen, 31·96; hydrogen, 8·05).

Due to the fact that small amounts of unidentified minerals are usually taken to be of high atomic weight (for example, gold, lead, etc.) in petrographic analysis, both the mean and effective atomic weights are found to be greater than those found by chemical analysis. For this reason chemical analysis is preferable.

Irrespective of the type of analysis, the mean atomic weight is found to be consistently greater than the effective atomic weight. It is more noticeable when the specimen consists of elements of widely differing atomic weights. The equation $A_{\text{eff}} = 1/\Sigma(P_i/A_i)$ seems to minimize the excessive contribution of high atomic weight elements to the effective atomic weight of a heterogeneous material. Most rock specimens have effective atomic weights between 18 and 20 and the deviation from 20 can be considered as a rough estimate of iron content in agreement with the suggestion of Birch[5].

R. C. MURTY

Department of Physics,
University of Western Ontario,
London, Canada.

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GEOLOGY

A New Occurrence of the *Didymograptus bifidus* Zone in the Skiddaw Group

THE Wet Sleddale extension of Manchester Corporation Waterworks' Haweswater scheme in Westmorland has involved the excavation of a tunnel, 4,000 ft. in length, to the west of Shap village. Excavated materials on the tips at both ends of the tunnel are principally grey-black shales and mudstones of the Skiddaw Group which have provided an abundant, well-preserved graptolite fauna. The fact that the collections have been made from the tip heaps is unlikely to detract from their value since a preliminary examination suggests that the *bifidus* zone alone is represented. This accords with the general position of the tunnel in the Skiddaw Group inlier hereabouts and with the presence in the tunnel of massive bands of reworked sand and tuffaceous material interbedded with the shales and mudstones. The tuffs can be compared with the mottled tuffs of the Lake District, and the situation as a whole recalls the Flagdaw-type interbedded slates and volcanics of the Cross Fell inlier.

A detailed investigation of the fauna is in progress, and, when completed, is expected to have a two-fold significance. First, it is complementary to the re-investigation of the graptolite zones established in the Skiddaw Group by Miss Elles[1], recently carried out by Jackson[2,3] in that part of the succession lying below the *bifidus* zone. Secondly, it will allow a definition of the *bifidus* zone of the standard British Ordovician sequence to be given in terms other than the association of the pendent didymograptids, *D. bifidus*, *D. artus* and *D. stabilis*[1]. In particular, the choice of *D. bifidus* as the zonal index species has proved unfortunate on several counts: as a middle member of an evolving stock it is difficult to identify[4]; the type material of the species, from Point Levis, Quebec, was yielded by beds which seem to correlate with (a part of) the British Arenigian (zones of *D. extensus* and *D. hirundo*); and it has a restricted geographical distribution.

I thank Prof. S. E. Hollingworth for the opportunity of examining this new material, and student members of this Department of Geology for assistance with collecting.

D. SKEVINGTON

Department of Geology,
University College,
London, W.C.1.

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Potassium–Argon Dates and the Origin of Wealden Glauconites

GLAUCONITE grains are scattered through the arenaceous facies of the English Wealden (pre-Aptian Cretaceous). They become sufficiently abundant to form dark laminæ and beds of 'greensand' at two horizons: (1) top Ashdown Sand; (2) top Lower Tunbridge Wells Sand (Fig. 1). Above and below, the facies is non-marine, sometimes freshwater. Little palæosalinity evidence is available from the sandstones themselves. Some of the glauconite grains have recalled abraded foraminiferal casts[1]. At present the balance of evidence favours derivation from older marine sediments. These could have been either Upper Jurassic or pre-Upper Carboniferous.

Associated detrital grains[2], pebbles[3,4] and clays[5] suggest Upper Kimeridge–Lower Portland (that is, Lower Volgian) sources. Around and beneath the Weald to-day the Portland Beds (presumably Lower[6,7]), and sometimes the Upper Kimeridge Clay, are sandy and glauconitic[6–10]. The top Ashdown glauconite of East Sussex is particularly abundant along a north-east–south-west tract[11] rich in

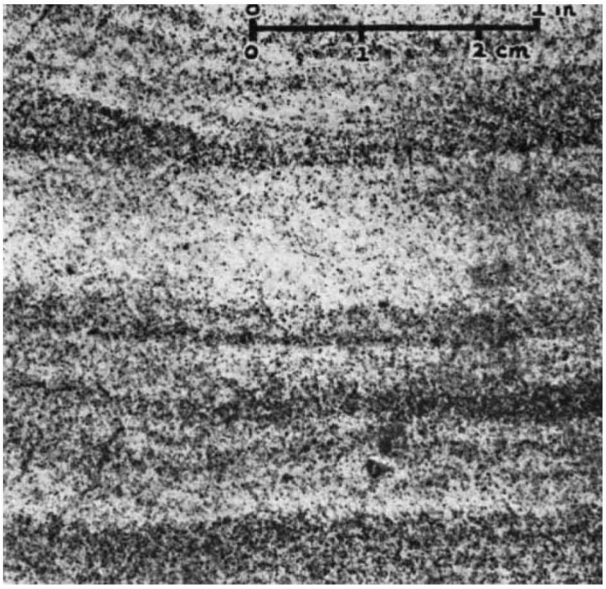

Fig. 1. Wealden laminæ rich in ? detrital grains of glauconite (black dots). Scoop No. 2, top Lower Tunbridge Wells sandstone, Philpots Quarry, West Hoathly, Sussex (ref. 19)