had similar growth rates, and a complex polyhedral habit developed. Among faces developed were the {001} and {011}. Lower growth rates were obtained in sodium carbonate solutions, while in stronger sodium hydroxide solutions precipitation of calcium hydroxide occurred. The use of a pressure of 1000 atmospheres did not have a marked influence on growth rates.

Contrary to the experience with silicate systems, corrosion proved a serious problem in unlined autoclaves. The quality of new growth was poor, and microscopic examination revealed particles of magnetite, Fe_3O_4, associated with the grown crystal. Experiments in a silver-plated autoclave were unsuccessful, as corrosion of this lining also took place in the alkaline solutions. However, when crystals were grown in a platinum tube contained in a 2 in. diameter autoclave, corrosion products were excluded, and good quality growth was obtained.

In separate isothermal experiments in gold tubes inside the autoclaves, small, slighly coloured crystals of calcium tungstate were spontaneously nucleated in the presence of trivalent chromium or of divalent manganese, showing that the introduction of suitable paramagnetic ions into hydrothermally grown crystals is possible.

The General Electric Co. Ltd.,
Central Research Laboratories,
Hirst Research Centre,
Wembley,
England.

P. B. HART
F. W. WEBSTER

References.

1. S. ZERFOSS, L. R. JOHNSON, and O. IMBER, Phys. Rev., 1949, vol. 75, p. 320.
2. L. G. VAN UITERT and R. R. SODEN, Journ. Appl. Phys., 1960, vol. 31, p. 328.
3. И. Н. Аникин [I. N. Anikin], Доклады Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1956, vol. 110, p. 645.
4. Idem, Кристаллография (Kristallografiya), 1957, vol. 2, p. 195.
5. C. S. BROWN, R. C. KELL, L. A. THOMAS, N. WOOSTER, and W. A. WOOSTER, Min. Mag., 1952, vol. 29, p. 858.
6. G. C. KENNEDY, Amer. Journ. Sci., 1950, vol. 248, p. 540.
7. K. NASSAU and A. M. BROYER, Journ. Appl. Physics, 1962, vol. 33, p. 3064.

Ages of some Tertiary intrusive rocks in Arran.

THE first results of an attempt to unravel the sequence of igneous rocks in Arran (Scotland) by radioactive age determination are presented (Table I). The ages so far obtained are grouped closely enough to suggest that the whole range of later igneous activity took place within

Palaeocene and Eocene times. An attempt to distinguish successive phases within this group must await the further analyses under way, including analyses of basic rocks. The petrography and structural relationships of the samples will then be described. However, without more detail, two conclusions, long assumed [1, 2, 3], may now be established.

TABLE I. Age determination of samples from Arran.

$\lambda_\beta = 4{\cdot}72{\cdot}10^{-10}\text{yr.}^{-1}$. $\lambda_e = 0{\cdot}584{\cdot}10^{-10}\text{yr.}^{-1}$.

Material.	K_2O %	$\frac{A_{atmos.}\ 10^2}{A_{total}}$	A^{40*} mm³ NTP/gm.	Age* and estimated error Myr.
Northern (outer) granite:				
HA 765				
Cioch na h'oighe, Sannox				
Feldspar and quartz ...	5·12	10·4	0·01126	65±6
Biotite	6·18	10·2	0·01267	61±6
HA 850				
Coarse granite, E. of An Tunna, N. Glen Sannox				
Feldspar and quartz ...	5·15	15·1	0·009589	55±5
,, ,,	5·11	26·1	0·009607	56±5
HA 849				
Porphyritic granite vein E. of An Tunna, N. Glen Sannox				
Feldspar and quartz ...	5·15	1·2	0·009940	57±6
Central complex granite:				
HA 781				
Dereneneach Quarry				
Feldspar and quartz ...	4·59	18·1	0·009731	63±6
HA 916				
E. of Tarrnacraig				
Feldspar and quartz ...	4·46	29·9	0·008965	60±6
,, ,,	4·30	21·7	0·009030	62±6
Quartz porphyry composite sills:				
HA 294				
Bennan Sill				
Feldspar and quartz ...	5·30	11·9	0·01086	61±6
,, ,,	5·39	33·2	0·01105	61±6

A atmos. is argon of atmospheric origin.
A^{40*} is radiogenic argon.
A total = A atmos. + A^{40*}.

λ_β = Decay constant for potassium-40 by β emission.
λ_e = Decay constant for potassium-40 by K electron capture.

* In millions of years, Myr.

The age of cooling of at least part of the Northern granite can be shown to be post Lower Devonian and its uplift probably post Triassic on local stratigraphical evidence. Its Tertiary age has been assumed because of the similarity of the whole Tertiary igneous province [2]—especially by comparison with granites of the Mourne Mountains in Ireland (measurements made in this laboratory indicate a Lower Tertiary age). That it cannot be much older than the other Tertiary igneous rocks is now confirmed. A similar age of 59 ± 3 million years was obtained for a phonolite plug near Loch Fyne while material from Centre 3 of Ardnamurchan yielded a figure of 55 ± 6 million years (Brown and Miller, in preparation).

The Central Complex of Arran [4] appears to be later than the Northern granite as shown by the relative displacement of adjacent strata and later than the collapsed masses within the caldera, the youngest of which are thought to be the amygdaloidal basalt [3, 4]. This basalt is generally correlated with the plateau basalt in other parts of the Brito-Icelandic province and offers the only palaeontological evidence for age from the associated plant beds.

Although these floras have long been taken as Eocene, more recent work suggests a Miocene age [5, 6]. A Miocene age was also suggested on palaeomagnetic evidence [7] but potassium-argon dating carried out in this laboratory on basalts from Mull and Antrim indicate that the plateau basalts originated in the Palaeocene (Miller and Musset, in preparation).

A later age for the basalts would raise most of the igneous activity in the Hebrides still further into the Upper Tertiary. Our results confirm the (traditional) Lower Tertiary age.

Dept. of Geodesy and Geophysics,
Madingley Rise, Cambridge.
J. A. MILLER

Sedgwick Museum,
Cambridge.
W. B. HARLAND

References.

1. A. GEIKIE, Trans. Geol. Soc. Edin., 1873, vol. 2, p. 305.
2. W. GUNN, The geology of North Arran, Mem. Geol. Surv. U.K., 1903.
3. G. W. TYRRELL, Ibid., 1928.
4. B. C. KING, Quart. Journ. Geol. Soc., vol. 110, pp. 323–356.
5. J. E. RICHEY, A. G. MACGREGOR, and F. W. ANDERSON, British regional geology Scotland: Tertiary volcanic districts, 3rd edn, 1961, p. 46.
6. J. B. SIMPSON, Trans. Roy. Soc. Edin., vol. 64, p. 16.
7. M. AFTAB KHAN, Geophys. Journ. Roy. Astr. Soc., vol. 3, pp. 45–62.