produced those showing on these latter specimens (that is, of course, when they have obviously not been detached by fortuitous blows).

(3) I find that by bringing pressure to bear upon a flint with a sharp edge resting upon a rounded pebble a "bay" can be produced upon the uppermost stone which has the appearance of a "hollow scraper" made by man.

By carefully watching one of these sharp-edged stones in the process of being flaked, it was seen that so long as the pressure was applied the flaking was continued.

The flint was evidently breaking along the lines of least resistance, and very thin flakes being removed, the hollow produced having a totally different appearance from one made by blows.

The reason for this difference was seen to be owing to the fact that as it is impossible to strike the flint near enough to its edge to remove flakes as thin as are detached by pressure, the hollow scraper produced by blows has a rougher appearance because each individual flake has cut deeper into the flint (Figs. 9 and 10). The hollow scrapers which are derived from the pre-river-drift deposits have obviously been produced by blows, delivered at a constant angle to the edge, and it is therefore concluded that man has made them.

It is, of course, possible that these early men in some cases may have edge-flaked their flints by pressure applied with another stone or a bone point, as the later Neolithic people did, but it does not seem likely that this was the case. Experiments were conducted with flint flakes covered by an inch or inch and a half of fine sand in an iron dish, and it was found that the greatest pressure obtainable with the differential screw-press was unable to break them.

A similar experiment was also conducted under the same conditions except that no iron dish was used and the sand was allowed to flow under the pressure. Here again, however, no fracturing of the flint took place. I think these results should induce caution in asserting that large stones lying under many feet of fine sand have been broken by pressure. I found that with pressure-flaking the small fissures in the flint, which are so common in flaking by percussion, are very rare, and I think this is due to the different methods of fracture. Also the surface of a pressure-flake is very seldom so glossy as that produced by a blow, which fact can perhaps be explained on the same hypothesis.

I may say that my experiments were carried through a great number of times with all sorts of flints, and the same results obtained.

In conclusion, I would like to state that specimens demonstrative of all the foregoing experiments are housed in the department of ethnology of the British Museum (Bloomsbury), and can be seen and handled by anyone who wishes to do so.

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12 St. Edmund's Road, Ipswich, November 25.

Excitation of γ Rays by α Rays.

IN a paper shortly to be published in *The Philosophical Magazine*, one of us has shown that when the α rays from radium C impinge upon matter, they excite a small but detectable amount of γ radiation. In continuation of this work a systematic investigation of the radiations from bodies which expel α rays has been commenced. So far the radiations from ionium, radio-thorium, and radio-actinium have been investigated. Working with a very strong source of ionium, we find that, after all radio-active products likely to emit β or γ rays have been removed by chemical treatment, ionium emits, in addition to its α rays, a certain amount of γ radiation, but no detectable amount of β radiation. The amount of γ radiation compared with the total α radiation is much smaller than that emitted by a typical γ ray product like radium C. The amount, however, is of about the same order as that excited by the α rays of radium C in external matter. Since there is no evidence of the existence of a product accompanying the ionium and emitting γ rays only, it is natural to suppose that these γ rays are excited either in the ionium or in the thorium which is mixed with it, by the α ays.

Analysis of this radiation by means of absorption measurements gave the interesting result that it consists of three types at least. The least penetrating of these consists of a radiation, the absorption coefficient divided by the density (μ/D) of which has a value in aluminium of about 400 (cm.)$^{-1}$, the second of about 8·2, and the third type, which has not been investigated in detail owing to the weakness of the source, of about 0·15, *i.e.* it is of about the same order of penetrating power as the hard γ rays from radium C, viz. 0·04. It will be noticed that the second type has approximately the same value of μ/D as the characteristic radiation of series L excited by X-rays in thorium, as found recently by Chapman. It is therefore natural to suppose that all three types are characteristic radiations of ionium of different series.

We find also that radio-thorium emits γ rays, and also a small amount of β radiation. This radiation has not been studied in as much detail, owing to the rapid formation by the radio-thorium of thorium X and subsequent products, expelling intense β and γ rays. The ratio of the amount of γ to α radiation emitted by radio-thorum is approximately the same as the corresponding ratio for ionium.

The results obtained with radio-actinium, which is the product in the actinium series corresponding to radio-thorium in the thorium series, and to ionium in the uranium series, are very different. Dr. Hahn has shown that radio-actinium emits, in addition to α rays, some soft β rays, and also a radiation which is either a hard β or a soft γ radiation. We have repeated his work, and find that it expels, in addition to soft β rays, γ radiation of two types, the more penetrating of which is of the same order of penetrating power as the hard rays from radium C. The amount of β and γ radiation emitted by radio-actinium, however, is much too large to be ascribed to α rays alone.

It has hitherto been supposed that radio-actinium is a single product, having a period of 19·5 days, but we have succeeded in showing that it consists of two successive products. The parent product has the period of 19·5 days, as found by Hahn, and emits little or no penetrating β or γ radiation, and very probably no α rays. The second product expels α, β, and γ rays, and has a period of about thirteen hours. So far we have not succeeded, by means of a single chemical operation, in separating completely one product from the other, but, by means of a series of operations, we have been able to obtain a fraction of either product free from the other. It is of interest to note that Dr. Geiger and Mr. Nuttall predicted, from their well-known relation between rate of transformation and range of α rays, that radio-actinium probably consists of two successive products, the first of these having the period of 19·5 days, as found by Hahn, and the second giving the α rays and having a period of about one day. It is seen that this prediction was surprisingly accurate.

We intend to continue this work by investigating the γ and β radiations expelled by intense sources of radium, polonium, thorium X, and other α ray products.

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December 16.