R. 33¹ belongs to *I. Fittoni* or *I. hollingtoniensis*, although, as I have remarked in the work cited, it is certainly distinct from *I. Mantelli*. I may add that the bone in that skeleton catalogued as a fragment of an ilium proves to be the glenoidal portion of the right coracoid.

V.—THE OCCURRENCE OF GRANITE IN A BORING AT BLETCHLEY.

By A. J. JUKES-BROWNE, B.A., F.G.S.

IN the winter of 1886–7 a boring was made at Bletchley Junction for the London and North-Western Railway Company, and acquired importance from the report that, after passing through the Oxford Clay, it had entered a mass of granitic rock.² Probably many readers of this MAGAZINE wondered why no detailed account of the boring was published after this announcement; but the reason was, that when inquiries came to be made, some uncertainty was found to exist as to the position and mode of occurrence of the granitic rock. My attention was recently called to the boring by learning that the water obtained from it was salt. I then obtained all the information I could with regard to the rocks passed through, and think the results are of sufficient importance for publication. The interest naturally centres in the supposed occurrence of granitic rock at a depth of less than 400 feet from the surface, and it seems desirable that the facts with regard to this should be placed on record.

The boring was made by Mr. Ebenezer Timmins, of Runcorn, under the superintendence of Mr. F. W. Webb, the Engineer of the L.N.W.R. Company. The work was personally directed by Mr. Arthur Timmins, to whom I am indebted for the particulars given below; Mr. A. Timmins tells me he had the first handling of all samples which were brought up, and that he took some trouble to ascertain the nature of the rocks through which the boring was carried, making analyses of several of the specimens himself. All this information he has generously placed at my disposal, and the following is his account of the boring.

Old well 148 feet deep. Boring commenced from bottom of well. Level of surface about 260ft. O.D. :—

	Thickness.	Depth.
	ft. in.	ft. in.
1. Depth of old well.....	—	148 0
2. Blue limestone	8 0	156 0
3. Blue clay	9 0	165 0
4. Black shale	1 0	166 0
5. Yellow clay	2 6	168 6
6. Brown clay	17 6	186 0
7. Blue limestone	1 0	187 0
8. Brown clay	5 0	192 0
9. Blue limestone	12 0	204 0
10. Blue clay	8 0	212 0
11. Blue limestone	5 9	217 9
12. Blue clay	6 3	224 0
13. Blue limestone	1 0	225 0

¹ *Op. cit.* p. 226.

² See Prof. Hull's letter, GEOL. MAG. Dec. III. Vol. IV. p. 139 (1887).

	ft.	in.	ft.	in.
14. Blue clay with septaria	36	0	261	0
15. Blue limestone	1	0	262	0
16. Blue clay with septaria	40	0	302	0
17. Blue limestone.....	3	6	305	6
18. Blue clay	4	6	310	0
19. Blue limestone	1	0	311	0
20. Blue clay	45	0	356	0
21. Indurated bluish limestone.....	22	5	378	5
22. Granitic rock	21	7	400	0
23. Clay	1	0	401	0
24. Granitic rock	6	2	407	2
25. Clay	2	10	410	0

The following observations are chiefly by Mr. A. Timmins, with a few remarks of my own on the samples which he sent me, and which are now in the possession of Prof. A. H. Green at Oxford.

No. 3 was a very hard blue clay.

No. 4. A bituminous shale containing iron pyrites.

No. 9. Sample preserved, a dark grey limestone, with well-marked oolitic structure, several Echinoderm spines, and some shell fragments.

No. 11. Samples preserved probably from this bed are of a grey shelly and partially oolitic limestone.

No. 13. Sample preserved from 224 feet, a light grey crystalline limestone, very hard, with glistening surfaces of calcite, possibly parts of Echinoderm tests and spines.

No. 14. A very hard clay full of septaria and pyrites.

No. 16. The same as No. 14. Samples of the septaria preserved and analysis made by Mr. Timmins with following result :—

Insoluble siliceous matter	9·800
FeO (originally FeCO ₃)	34·418
Fe ₂ O ₃ , iron peroxide	33·423
Alumina ..	3·392
Calcium carbonate	17·050
Magnesium carbonate.....	2·291

100·374

Nos. 18, 19, and 20. These beds were full of fossils, but all the larger specimens were broken up by the chisels; those preserved are chiefly fragments of the stems and arms of small Crinoids, with several pieces of small Belemnites and fragments of bivalve shells. They are just such fossils as would occur near the base of the Oxford Clay.

No. 21. No sample preserved, but described by Mr. Timmins as a "very hard limestone." At about 360 feet it contained hard nodules or boulders of stone of a dark buff colour and having cracks filled up with calcite; they were calcareous and ferruginous, with only 15 per cent. of insoluble matter. A sample from 370 feet had the following composition :—

Insoluble matter	53·48
Oxide of iron and alumina	20·40
Calcium carbonate	26·06

99·94

My colleague, Mr. A. G. Cameron, has sent me a piece of Kellaway rock, from Kempton, near Bedford, which is a very hard, compact,

greyish-brown ferruginous and siliceous limestone; the general character of this rock is such as to suggest a chemical composition similar to that of the above analysis of the "indurated limestone" in the boring, and it has cracks filled with calcite.

Mr. Timmins says that from the foreman borer's account it would appear that this bed gradually got harder and harder till they came on to the "granitic rock" at 378' 5", and that the depth of colour also increased to a rusty brown.

No. 22. The following are Mr. Timmins' notes on this rock:—"The boring of this bed proved a very tedious operation, averaging about five inches a day, and owing to this incessant grinding of debris, large particles of rock were not to be expected: what samples there are were found after sifting the whole debris through a sieve of 1225 meshes to the square inch. The analysis of a bulked sample between 378' 5" and 390 feet is as follows:

Insoluble matter	80.106
Oxide of iron and alumina.....	11.514
Calcium carbonate.....	3.838
Magnesium carbonate	.640
Alkalies, etc., not determined	3.902
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100.000	

Before analyzing this sample, all particles of steel and iron from the boring tools and casing tubes were extracted as well as possible with a magnet; but it is possible that some of the 11½ per cent. of iron is derived from the mechanical appliances in use."

Samples of this material are preserved in bottles, the larger fragments are undoubtedly pieces of a granitic rock; the finer material which has passed through the sieve is of a brownish colour, and has the appearance of a pounded, fine-grained ferruginous sandstone. More will be said of this in the sequel.

Bed 24 was similar to bed 22, but was not so hard and compact, so that more rapid progress was made through it.

Beds 23 and 25 were clays with a blue colour when first brought into daylight, but after a few days in the air the colour began to fade, and through gradual gradations it arrived at a light brownish tint; this is probably due to the oxidation of the iron. An analysis of one of these clays gave the following results:

Insoluble siliceous matter	79.807
Oxides of iron and alumina	13.778
Calcium carbonate.....	2.997
Magnesium carbonate	1.718
<hr/>	
98.300	

Mr. Timmins remarks that it had somewhat the aspect and composition of a fire-clay. As the sample sent to me had rather a powdery felspathic look about it, I forwarded it to Prof. Bonney, who reported that it appeared to be an ordinary clay, "such as might well occur in the Jurassic series"; and that it was not a decomposed igneous rock or felspar rolled *in situ*, and had certainly not been baked by contact with igneous rock, as it must have been if the beds of "granitic rock" were intrusive sheets.

To complete the record of the boring, it may here be mentioned that water was found at the depth of 390 feet 9 inches in the first bed of "*granitic rock*," and again in the lowest clay at 410 feet, or more probably from a bed immediately underlying this clay, but not pierced. In both cases the water was very salt and unfit for use, so that the boring was abandoned and a coffee-house is now built over the site.

We may now revert to the so-called "*granitic rock*." It has already been stated that fragments of such a rock do certainly occur among the samples, and there seems no reason to doubt that these fragments were brought up from the depths named. As evidence on this point I quote a letter from Mr. A. Timmins to Mr. Cameron, dated November 19, 1886:—"I enclose a sample of the strata from present depth (390 ft.) . . . I make it out as hornblendic granite, and have had suspicions for some time. A few weeks ago my father brought home a piece of stone similar to the sample, and said that he was told by the foreman that it had come up the boring. Ever since I have sieved the samples sent to me, and Saturday was the first time, since that above mentioned, that I was able to get any larger pieces. My suspicions were at once confirmed, and I make out that we have bored through 10 feet of this granitic rock." With this evidence we may I think take it for granted that pieces of a granitic rock did come up from the depths stated in the account of the boring.

Next as to the nature of the rock: two small fragments were sent to Prof. Bonney, who was kind enough to examine them and reported as follows: "The fragments which you have sent me are of a rock closely allied to granite. As far as I can see with a strong lens they are likely to belong to the microgranulite of Fouqué and Lévy—that is, a rock with felspar quartz and mica or hornblende (probably the latter in this case) in a sort of fine mosaic; the individual grains not being very definite in form unless showing a micrographic structure. It is not a *true* granite, and yet it is rather too crystalline for a normal quartz-felsite . . . I never saw one like it among the Midland Palæozoics, but it has a general resemblance to the rocks of the Narborough district." There is no proof however that the whole of the thickness given to "*granitic rock*" in Mr. Timmins' account of the boring consisted of the rock above described; there is indeed strong evidence for the belief that it did not. In the first place I am informed by Mr. Cameron that he went over to Bletchley at the time they were boring through this rock, and selected small samples out of the foreman's box from depths of 391 feet and 393 to 396 feet. These he has kindly sent to me, pointing out that they are simply sandstones, without any trace of granitic fragments or minerals. The first is a light-coloured and fine-grained sandstone composed of small quartz grains with ferruginous staining; the second is a dark brown ferruginous sandstone. Both are such rocks as occur in the Kellaways Beds at the base of the Oxford Clay, and the only way of reconciling their existence with the recorded occurrence of granitic rock at about the same depth

is to suppose that boulders and blocks of the latter rock are here imbedded in the Kellaways sandstone.

This explanation would necessitate our assigning a thickness of more than fifty feet to the Kellaways Beds, which is more than usual, but Mr. H. B. Woodward tells me that these beds vary considerably in thickness, and that there would be nothing surprising in their having a depth of 50 feet. We might indeed expect them to be thicker than usual at a locality where they included large blocks of a foreign rock. On this supposition, moreover, the occurrence of an ordinary clay at the bottom of the boring is naturally accounted for; whereas if the material above were assumed to be a massive igneous rock, its presence would be anomalous and very difficult to explain.

It has already been mentioned that springs of saline water were found at depths of 390 feet and 410 feet. Mr. A. Timmins has kindly furnished me with analyses of these waters, and they happen to supply further evidence that the beds from which they issue belong to the Kellaways group. The analyses show 340 grs. and 392 grs. of solid matter in the gallon, the following being the principal ingredients:

	Highest Spring.	Lowest Spring.
Combined chlorine	75.00	91.40
Sulphuric anhydride	108.08	123.24
Calcium oxide	20.02	9.98
Magnesium oxide	4.89	4.37
Residue principally soda.		

These proportions are equivalent to about 123 grains of sodium chloride in the highest water, and 150 grs. in the lowest, with 162 grs. of sodium sulphate in the first, and 185 grs. in the second.

My attention has been called to a Report on Bedfordshire well-waters by Dr. C. E. Prior to the Rural Sanitary Authority of the Bedford District (1888), in which mention is made of a band of "saliferous rock" which appears to extend with the Oxford Clay formation from the northern border of the parish of Kempton, across Wootton, and some way into Stanton." He gives partial analyses of some of the well-waters which derive their supply from this rock, and the results show a remarkable correspondence with the Bletchley well-water. The amounts of total solid matter in solution vary from 188 grs. to 250 grs. per gallon. Chlorine is present in all of them, varying in amount from 38 grs. to 92 grs. per gallon. Sulphuric acid is present in several and sulphurous acid in one. Thus at Lower Shelton Marston, which is not many miles north-east of Bletchley, a well-water contained 209.8 grs. of solids per gallon, 72.1 being chlorine and 47.8 grs. being sulphuric anhydride. Dr. Prior comments on the very large quantity of sodium chloride which these waters appear to contain.

There can be little doubt that the saliferous rock of Dr. Prior is one of the beds in the Kellaways group, for all the places he mentions are situate on the lower part of the Oxford Clay.

To sum up, the information available with regard to the boring at

Bletchley points to the conclusion that the Kellaways beds are there thicker than usual, that they include blocks of a peculiar kind of granitic rock, and yield a saline water which contains large quantities of sodium chloride and sodium sulphate.

The occurrence of blocks of microgranulite naturally suggests the possible proximity of some portion of the eastern Palæozoic land. It is generally conceded that the floor of Palæozoic rocks which underlies the eastern counties formed part of a land area during the greater part of the Jurassic period, and indications of the neighbourhood of land are especially abundant in the Great Oolite group which underlies the Oxford Clay. How far the Oxford Clay sea encroached on this land area we do not know, but at the time of the Kellaways Rock the shore is not likely to have receded far from the line which it occupied in Great Oolite times.

The granitic boulders may have been carried to their present position by floating trees borne by currents from the eastern land; or they may have formed part of a small island which had been gradually reduced in size by the encroachments of the sea till a more rapid subsidence enabled the waves to complete its destruction; the last peak of the microgranulite may have been broken up in a storm, and its component blocks scattered over the surrounding sand-banks. Let us hope that other borings in Buckinghamshire may afford further information on this point; and if I were asked to indicate a site for a trial boring in search of the Palæozoic floor with its possible Coal-measures, I should mention the neighbourhood of Aylesbury.

VI.—PALÆONTOLOGY IN THE MALTON MUSEUM.

By A. SMITH WOODWARD, F.G.S., F.Z.S.

AMONG the local Museums of recent foundation, it would be difficult to find one of more scientific interest and importance than that of the Malton Field Naturalists' and Scientific Society. The commencement of the collection, indeed, was made so lately, that it might naturally be expected to have attained little beyond the nucleus-stage; but as an exponent of local Natural History it already rivals many of the older Museums, and the object of the present notice is briefly to call the attention of palæontologists to the material it affords for all interested in the investigation of Jurassic and Cretaceous fossils.

The oldest portion of the Palæontological collection is a series of Corallian fossils obtained many years ago in the neighbourhood of Malton by Mr. S. King; but the recent discoveries form by far the greater portion of the series, and these have been collected by Mr. Samuel Chadwick, F.G.S. The only difficulty presented to the student is the limited amount of cabinet and exhibition space, which renders it impossible to arrange more than a small typical collection, and it is to be hoped that, ere long, the Society will be in possession of sufficient funds to erect the long-projected new building, and rescue the stowed-away treasures from the dark cellars in which they are still placed.