D'ARCY EXPLORATION COMPANY LIMITED

Geological Division

Report R.G.M. 4.

GEOLOGICAL COMPLETION REPORT ON

A R R E T O N No.1 W E L L

ISLE OF WIGHT.

by

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GEOLOGICAL REPORT ON ARRETON NO. 1 WELL.

ISLE OF WIGHT

Based on a compilation by R.G. MacLean, supplemented by P.E. Kent with Appendices by W.D.V. Jones, H.M. Muir-Wood and F.W. Anderson.

SUMMARY.

The Arreton No. 1 Well was sited on a subsidiary dome of the Brook Bay - Sandown anticlinal line in the Isle of Wight defined by geophysical (reflection) survey, and horizontality of beds encountered showed it to have been accurately located on the crest.

Drilling began in the Ferruginous Sands (Aptian) and continued into Middle Inferior Oolite. A normal succession of Lower Cretaceous and Jurassic beds was penetrated with only minor stratigraphical breaks. In facies the beds compared closely with Dorset and with Portsdown No. 1, and thicknesses were in general comparable with the latter, reduced as compared with the easterly Isle of Purbeck development.

Only very slight traces of oil were encountered despite the moderate development of reservoir beds, and the lack of success is ascribed to early migration of oil towards the edges of the contemporary basin before formation of the Arreton structure, and possibly also to a strong phase of Lower Cretaceous movement about which little is at present known.

1. WELL DATA

Position	Longitude	1° 14' 55.2" W
	Latitude	50° 40' 2.9" N
Rotary table Elevation		125'
Rig		136' Derrick
Drive		2 Paxman 200 H.P. Diesel
Draw works		Ideal 50
Pumps		1 National C 250 1 National C 150
Spudded in		12th October 1952.
Drilling Completed		19th April 1953.
Plugged and abandoned		29th April 1953.
Total depth		5161'
Casing		16" cemented at 285' 11¾" " " 2250'
Diameter of Hole		19" to 291' 14¾" " 2256' 10⅝" " 4008' 8⅝" " 4431' 7⅞" " 5161'
Deviation of Hole		¼° to 280' ½° " 662' ½° " 1054' ¼° " 1330' ¼° " 1630' ½° " 1950' ½° " 2210' ¼° " 2575' 1½° " 3895'
Abandonment	Cement plugs 1.	3590 - 4000'
	2.	1900 - 2350'
	3.	18 - 118'
	Viscous anti-corrosive placed between and beneath plugs.	

2. SUMMARY OF FORMATIONS

		Thickness		To -	
Lower Greensand		210		210	
Wealden		2010		2220	
Purbeck		343		2563	
Portland		87		2650	
Kimmeridge Clay		1107		3757	
Corallian		216		3973	
Oxford Clay		450	549	4423	
Kellaways Beds		99		4522	
Cornbrash		19	539	4541	
Great Oolite Series		196		4737	
Fullers Earth		152		4989	
Inferior Oolite	to	172		5161	(bottom)

POROUS BEDS were encountered in the Wealden (sands up to 23% porosity), Purbeck (limestone up to 11% porosity), Corallian (limestones up to 4% porosity, but with large voids), Kellaways (sands to 9% porosity) and Inferior Oolite (up to 2.4% porosity). Details are given in Appendix B.

3. OIL INDICATIONS

Though slight oil indications occur from the Wealden downwards they are rather disappointing. The best indication was a 4" strongly bituminous brown limestone in the anhydrite of the Basal Purbeck.

Wealden:

No free bitumen or oil was observed in the sands but an amber colouration in chloroform or a faint fluorescence in Ultra Violet Light could usually be obtained, most strongly in association with the carbonaceous beds.

Purbeck:

Chloroform extracts of all limestones gave fair to good fluorescence in Ultra Violet Light and frequently imparted an amber colour to chloroform while some had a faint smell of oil when crushed.

From 2439', many limestones have bituminous marl laminations.

2543' - 45' Anhydrite with soft bitumen on fracture surface.

2554' - 60' Anhydrite with thin bituminous marl partings and an oily smell. Towards its base is a 4" band of brown compact limestone with a strong oily smell and colours chloroform dark brown.

Portland:

Chloroform extracts of all sandstones and limestones gave fair to strong fluorescence in Ultra Violet Light.

2563' - 64' Laminations of bituminous shale and fawn limestone with strong smell of oil.

2566' - 2582' - 2602' Limestones with faint oil smell when fractured or crushed.

Kimmeridge:

The shaley clays which compose most of the succession are often faintly bituminous. In addition, beds of brown bituminous shale occur throughout the series. These are well developed between 2895' - 2950' and one of them is probably equivalent to the "Kimmeridge Coal" which outcrops in Dorset.

Corallian:

Chloroform extracts of some limestones tested were faintly straw-coloured and all gave fair to good fluorescence in Ultra Violet Light.

3775' - 93' some brown bituminous shale in cuttings.

3833' limestone with a thin black bituminous clayey shale parting.

Oxford Clay:

Traces of brown bituminous shale occur throughout the series. These are fairly well developed over the basal 60' as in Dorset.

Cornbrash and Great Oolite:

Traces of brown bituminous shale were found in the argillaceous part of the succession.

Chloroform extracts of the limestones and sandstones had slight to good fluorescence in Ultra Violet light. Extracts from 4534' - 40', 4573' - 78' and 4608' - 17' were faintly straw-coloured.

Fuller's Earth:

Traces of brown bituminous shale occur in the Upper and Lower Fuller's Earth.

Chloroform extract of the Fuller's Earth Rock had a faint straw colour.

Inferior Oolite:

Chloroform extracts of the limestones gave slight fluorescence in Ultra Violet Light.

4. PRODUCTION TESTS

In order to simplify the general programme it was decided not to test the Wealden in this well but to concentrate attention on lower horizons, drilling a subsidiary well later if Wealden horizons proved to justify attention. The first test was consequently carried out in the Purbeck beds.

Tests were carried out with a Johnson/Halliburton assembly using an Amerada pressure recorder. It was unfortunate that positive results were obtained in only two of the six formation tests, although two others were mechanically satisfactory and failed only through impermeability of the formation under test.

Formation Test No. 1. 1.1.1953. (Purbeck):

14¾" casing shoe at	- 2250'
10½" Packet Set at	- 2238'
Interval Tested	- 2250' - 2306'
Valve open	- 3 hrs. 59 mins.
Average Production Rate	- 130 galls/hr. of salt water. Approx. back pressure 29 p.s.i.
Reservoir Pressure	- None recorded.

After landing on bottom, the trip valve opened before the Packer effected a shut off and no reservoir pressure was recorded. At the conclusion of the test, the retaining valve leaked and some additional mud entered the drill stem. The total production was equivalent to 2.2 dump volumes. 1200' of fluid was retained above the trip valve. Salinities of selected samples are as follows:-

Circulating mud	620 p.p.m.
Sample 900' above T.V.	6450 p.p.m.
sample 300' above T.V.	9480 p.p.m.

Formation Test No. 2. 11.1.1953. (Purbeck):

10½" Packer set at	- 2360'
Interval Tested	- 2360' - 2416'
Valve open	- 1 hour
Production	- Nil
Reservoir Pressure	- None recorded.

The Amerada chart confirmed that the test was mechanically satisfactory. The formation was too impermeable to record a reservoir pressure during the hour that the retaining valve was open before starting the production test.

Formation Test No. 3. 22.1.1953. (Basal Purbeck - Portland):

7¼" Packer set at	- 2555'
Interval Tested	- 2555' - 2581'
Valve open	- 1 hour 17 mins.
Production Rate	- Nil
Reservoir Pressure	- None recorded.

The Amerada chart confirmed that the test was mechanically satisfactory. The formation was too impermeable to record a reservoir pressure.

Formation Test No. 4. 21.2.1953. (Corallian):

7¼" Packer set at	- 3865' 9"
Interval Tested at	- 3866' - 3921'
Valve open	- 3 hours.
Production	- 2.2 cu. ft. in 7 mins.
Average pressure	- 185 p.s.i.
Reservoir Pressure	- None recorded.

The Production of 2.2 cu. ft. of mud possibly from a piece of core at the bottom of the hole, which was crushed during the setting of the packer. The tool consequently "spudded down" filling thin empty single with mud.

A falling Reservoir Pressure was recorded by the Amerada but was far from equilibrium.

Formation Test No. 5. 19.3.1953. (Kellaways):

Interval Tested	- 4441' - 4492'
Production	- Nil.

The rubber failed to pack off and 100 cu. ft. of mud from the Annular Space entered the drill pipe. An attempt was made to reset the packer but failed and it was only after 35 minutes pulling that the packer came free. When recovered, the rubber was found to be badly torn.

Formation Test No. 6. 19.4.1953. (Inferior Oolite):

Interval Tested - 4994½' - 5161'

Production - The tester valve was open for 1 hour and for a further 52 minutes while attempting to shut the retaining valve to obtain a reservoir pressure. The overall production rate was 40 cu.ft./hr. declining to 2 cu.ft./hr. at the end of the list.

Reservoir Pressure - None was obtained in 1½ hrs. before the Production test. Presumably the retaining valve opened before the packer was set.

Samples — 14 cu.ft. of mud and salt water (estimated chloride content 25.400 p.p.m.) were produced. This represents about one third of the sump volume as since the drill stem contained approximately 70% formation water, production probably came from the formation opposite the anchor string, i.e. 4995' - 5005'.

5. STRATIGRAPHY

Formations down to the Corallian were logged by A.E. Pedder; beyond this by R.G. MacLean. Modifications have been made to the Wealden and Purbeck boundaries as a result of the micro-faunal investigations of Dr. F.W. Anderson (Appendix D.2). Advice from Mr. R.V. Melville of the Geological Survey was valuable in identification of the Kellaways, and investigation of the brachiopod fauna by Dr. H.M. Muir-Wood has clarified our views on the lower boundary of the Fullers Earth (Appendix D.1).

A. LOWER GREENSAND - 0' - 210'

A.1. Ferruginous Sands. 0' - 170'

170' of this group were penetrated, developed as at outcrop as vari-coloured series of sands and sandstones which became finer towards the base.

The top 50' are made up of yellow and yellowish brown glauconitic sands with sub-angular and rounded grains up to 1 m.m. In the next 10' the sands are more reddish brown in colour and accompanied by some rounded polished pyrites pellets. These are succeeded by 30' of greenish-brown glauconitic sandstones and sands also with pyrites pellets and some fine grained sandstone with a marcasite matrix. The next 40' are mainly grey sandstones in which chert is common along with pyrites and marcasite, and from 130' - 170' there are 40' of buff coloured, fine, slightly micaceous sandstone and siltstone with small specks of carbonaceous matter.

A.2. Atherfield Clay. 170' - 210' (40 feet thick)

The top of this subdivision is grey clay and hard siltstone also with carbonaceous matter, pyritised wood and rare shell fragments. At the base of this is 5' of fawn silty sandstone, green and grey fine to medium sandstone with glauconite, much pyrites, a little ironstone and a few shell fragments. The lower beds are made up mainly of dark blue-grey silty clay, slightly micaceous with rare specks of carbonaceous matter and pyrites and traces of grey and fawn silty sandstone.

It may be noted that this classification (suggested by F.W. Anderson from ostracod evidence) gives a much smaller thickness of Atherfield Clay than is recorded at outcrop (60-85 feet). Pedder's original grouping was - Ferruginous Sands 0 - 205 feet, Atherfield Clay 205 - 280 feet, Wealden from 280 feet onwards, and this may yet prove to coincide more accurately with the outcrops.

B. WEALDEN - 210' - 2220'. (2010 feet thick)

The Arreton well provided the first complete section of the Wealden in the Isle of Wight and showed (as expected) a strong similarity to Dorset. Thicknesses were however less than at Swanage, so that the easterly expansion traceable across the Isle of Purbeck must be reversed still further into the Tertiary basin.

B.1. Wealden Shales. 210' - 390' (180 feet thick)

At the top of this group are dark clays much like the Atherfield Clay, and at 280' there is a bed of brownish grey recrystallised shelly sandy and pyritic limestone associated with grey shale containing ostracods and phosphatic fish remains.

Thereafter the beds are made up mainly of dark grey and fawnish grey shale, silty and slightly micaceous in parts and with

streaks of very fine light grey sandsone. Scattered throughout are fish remains, ostracod and lamellibranch fragments, carbonaceous matter and rare traces of pyrites. Traces of fawn shelly limestone occur in the top 20'. The beds become more arenaceous towards the base and from 340' - 375', bands of fine tight grey silty sandstone occur, underlain by 15' of beds containing some fine greenish-grey glauconitic sandstone with lignite fragments in the last 5'.

The drilled thickness of Wealden shales, 180', compares with 92 and 220 feet at Compton Bay, 192' at Atherfield and 170' at Sandown, the localities where this group outcrops on the Isle of Wight. In the Portsdown well the thickness was only a few feet, and the rapid thickness variation probably reflects a minor phase of relative movement - an episode independently indicated by the presence of derived Kimmeridge ammonites (Pavlovia)in the basal Wealden at Sandown.

Could be ex-London Platform?

B.2. Wealden Marls, 390' - 2220' (1830 feet thick)

The Wealden Marls are mainly variegated beds of reddish brown, pale green, grey and fawn coloured clays and marly clays. Beds of light grey and fawn fine to coarse sandstones, grit and pebbly grit become more common in depth. Fragments of lignite are usually associated with the sandstones. Towards the base, the variegated clays and marly clays are less common and become more calcareous. Overlying the Upper Purbeck Marble at 2229' are 60' of grey and greenish mottled marls and marly clays, silty and sandy in places with streaks of very calcareous coarse sandstone containing pebbles of amber calcite and conspicuous bright green and black partly rounded pebbles up to 3 mms.

There is no clear-cut lithological boundary between the Wealden & Purbeck. The boundary has been placed tentatively at 2220', a few feet above the Upper Purbeck Marble limestone.

Dr. F.W. Anderson made a brief preliminary examination of the samples for ostracods and identified Cypridea henfieldensis from 825' - 830', Metacypris fittoni and Pseudocypridina laevigata from 1490' - 1495'. A more detailed account is given in Appendix D.2 (attached); six of the more known Wealden Zones have been identified.

C. PURBECK, 2220' - 2563' (343 feet thick)

The three subdivisions of the Purbeck Beds are clearly marked and characteristic.

The Upper Purbeck Marble (limestone) was encountered at 2229' and from there to 2349', grey and fawnish grey recrystallised shelly limestones with green staining predominate with thin bands of grey shaly marl. Small gastropods including Viviparus, cf. Valvater, Cyrena ostracods occasional lamellibranchs are present. The "Cinder Bed" was encountered between 2323½ and 2328', and had abundant Ostrea distorta towards the top.

From 2349' to 2376' a compact porcellanous mudstone predominates and contains occasional Ostracods, gastropods and plant remains. This is underlain by some partly oolitic limestone down to 2404'.

The top of the Lower Purbeck is marked at 2404' by anhydritic and sandy limestone which continues to 2413'. Anhydrite then predominates to 2433 and overlies beds of compact limestone, anhydritic, detrital and oolitic in parts with bands of shaly marl down to 2519'. From 2519' to the base of the Purbeck at 2563', the formation is predominantly anhydrite with irregular laminations of bituminous marl

and brown compact limestone. At 2560' a 4" band of brown compact limestone was strongly impregnated with oil - the strongest show noted in the well.

D. PORTLAND, 2563' - 2650', (87 feet thick)

The undulating junction between marine Portland and the Purbeck anhydrite at 2563' is clearly marked in an unbroken core. This may mark the level of a stratigraphical break, as is found in the Weald. (See Report U.K.100).

From 2563 to 2573', grey argillaceous, slightly sandy limestone with Trigonia, and Pecten predominates. Parts of large ammonites show in the cores almost like ripple marking. In the next 10' the limestone is oolitic, sandy and glauconitic and has a 2' band with black cherts (?lydites) up to 1.5 m.m. between 2573' and 2575'.

From 2575' to the bottom at 2650' the beds vary between grey sandy glauconitic shelly limestone and fine-grained glauconitic sandstone. Traces of shale occur in the samples. These beds at least belong to the Portland Sand, and by comparison with Portsdown it is suspected that the sandy limestones should also be grouped with that subdivision and that the Upper Portland is missing.

At 2650' there is a marked change to silty shales indicating the lithological top of the Kimmeridge. The junction is gradational, as in other places.

E. KIMMERIDGE CLAY, 2650' - 3757' (1107 feet thick)

The Kimmeridge thickness and development is similar to that at Portsdown and Henfield; the expanded development of the type area in the Isle of Purbeck does not extend to the neighbourhood of Arreton.

Bituminous shale intercalations occur throughout the succession and are particularly in evidence from about 2895' to 2950'. Traces of laminated cement-stone occur over the latter interval and it is probably equivalent to the group which includes the "Kimmeridge Coal" in Dorset.

From approximately 3375' onwards the series is slightly more calcareous and occasional pieces of argillaceous limestone occur in the samples. These may represent thin beds but some at least are probably fragments of large nodules.

Conspicuous limestone bands occur near the base at 3699' - 3702' and 3705' - 3711' respectively. Both are fine grained recrystallised, slightly sandy limestones with occasional recrystallised rotalids. Amoeboceras cf. cricki and Pictonia occurring at 3748' were identified by Dr. Arkell.

There is no lithological change marking the Kimmeridge/ Corallian boundary. Initially this had been placed at 3752' on top of a 5' bed of clay which had a soapy texture. Some ammonite fragments from this bed were subsequently identified by Dr. Arkell as Pictonia sp. and Prorasenia sp. indicating Kimmeridgian date. From 3765' he identified Amoeboceras cf. prionodes indicating Upper Corallian age, and on the basis of these fossils the boundary is placed at 3757'.

F. CORALLIAN, 3757' - 3973' (216 feet thick)

There is a good general correspondence with the western Dorset succession, and it is likely that the depositional facies was closely similar. The extra iron-bearing subdivisions proved in the unusually thick succession of Broadbench and at Poxwell were however not present at Arreton.

In the following account the beds are classified mainly on lithological correlation with Western Dorset; this is supported by the few fossils found but there may not be precise contemporaneity of similar beds.

Ringstead Beds, 3757' - 3775' (18 feet thick)

There is no representative of the very local Ringstead Coral Bed, but the 18' of dark grey shales with scattered irony mudstone nodules yielded Cidaris spines, Lingula, Pecten and Lucina in addition to the above mentioned ammonites.

Sandsfoot Grits and Clays, 3775' - 3822' (48 feet thick)

Incoming of brownish sandy shales at 3775' - 81' is taken to indicate the Sandsfoot Beds. Beneath is an alternation of similar beds with grey shales, passing down to shaley sandstones at 3814' - 20'.

Trigonia Clavellata Beds & Osmington Oolite, 3822' - 3908' (87 feet thick)

The sequence between 3822' and 3870' is of grey medium-grained granular crystalline limestones interbedded with calcareous shales. The limestones frequently have calcite filled fissure, vugs and shell cavities, some of which are as much as two inches across. From 3870' to 3909' the limestones are oolitic, with two or three shale beds in the first 16'. In the interval 3846' - 66' open recrystallised limestones continue, and there is a dense shaley limestone in the lower part with recrystallised corals. A large branching coral was seen in the upper part of the 3866' - 82' core; beneath this (say 3875 - 82' and also 3901 - 10') the beds become more marly and limy segregations give a nodular structure which would probably be represented by a rubbly limestone at outcrop.

Bencliff Grits, 3909' - 3923' (14 feet thick)

This group is represented by a massive grey gritty limestone with streaks and pockets of finely gritty marlstone showing wispy current bedding. Towards the top it is shelly in parts and has occasional oolite streaks while towards the base it becomes more marly and small pyrites specks and nodules become commoner, but remains finely sandy with wispy bedding, trails and worm borings. There is a passage to the beds below.

Nothe Clay, 3923' - 3954' (31 feet thick)

The group is made up of grey slightly calcareous shales which are slightly sandy in the top 3 feet. They are poor in fossils but occasional small lamellibranchs resembling Nuculana (Leda), small "Myas" and Pecten cf. fibrosus. In the bottom 1', shell banks are developed and may be equivalent to the Gryphaea dilatata beds at the base of the Nothe clay in Dorset.

Nothe Grits, 3954' - 3973' (19 feet thick)

The top 3' of this group is a grey shelly limestone, shaley in parts. Oyster beds occur near the base and contain Chlamys cf. fibrosa and Ch. splendens. This horizon may be equivalent to the Trigonia hudlestoni bed in Dorset.

Separated from this bed by 1' of grey shale is a further 8' of predominantly limestone beds. These are generally dense fine-grained crystalline limestone, frequently containing shell fragments and marly in parts, particularly at the base.

Thereafter the beds are more argillaceous and are made up of alternating marls and shales which are locally slightly sandy and contain Exogyra nana and other small lamellibranchs.

G. OXFORD CLAY, 3973' - 4423' (450 feet thick)

There is no sharp lithological change from the Corallian to the Oxford Clay and the boundary has been placed at 3973' where a few ironstone nodules occur - as in Portsdown No. 1, where palaeontological control was available. Several Cardioceratid ammonites obtained from about 3984' should provide a check on the boundary at Arreton when identified.

The top 250' of the formation is made up of grey and fawnish-grey marls with bands of silty shale. The marls are frequently pyritic and occasionally shell fragments and traces of brown bituminous shale occur throughout.

Over the bottom 200', the formation becomes less calcareous and more shaley and in the lowermost 60' brown bituminous shales are more strongly developed. This arrangement agrees not only with the Dorset development but also with the succession at Henfield No. 1 and other places.

H. KELLAWAYS BEDS, 4423' - 4522' (99 feet thick)

The Kellaways Beds represent the most unusual element in the Jurassic column, being far thicker than the average in southern England.

The greater part (4431' - 4512') was cored, and consisted essentially of fine sandstone with greater or lesser amounts of clay - varying from a muddy sandstone to a sandy marl. Fine wispy current bedding was developed locally, and there were rare cement-stone nodules.

At 4471' a one-inch bed of pyritic fissile limestone contained common lamellibranch shells, but for the most part fossils in indifferent preservation were scattered through the sandy beds. Among the few ammonites Proplanulitid types occurred between 4435' and 4451'. Ostrea alimena (a reliable Kellaways index) was identified by R.V. Melville throughout the succession. Trigonia sp. occurred occasionally, Pecten vagans was found at 4438', Thracia depressa occurred at various levels (e.g. 4499') showing the irridescent preservation characteristic of the Kellaways, and Melville found also Palaeoneilio (4497' and below). The fauna leaves no doubt of the date of the entire group.

Thick developments of Kellaways in other places tend to occur in areas of relative contemporaneous uplift near the edges of basins (more accurately - areas of restricted subsidence) as near the Mendips and in the Market Weighton district. Figures are too

scanty to serve as a basis for firm conclusions, but this 99' thick development provides a suspicion that a contemporaneous "high" existed nearby - perhaps to the south or east of the Isle of Wight.

J. CORNBRASH, 4522' - 4541' (19 feet thick)

It had been originally intended to core the Cornbrash but the abnormal Kellaways development temporarily confused correlation, and we have only cuttings available, with no palaeontological confirmation of date.

The formation is a white and grey speckled limestone, seen to be raggy and echinoidal in thin section. Odd fragments of Terebratulids can be recognised.

The Cornbrash here is distinguished from the Great Oolite limestones beneath (also represented only by cuttings, examined in thin section) in being slightly ferruginous and in lacking the finely recrystallised texture which affects many parts of the latter. The brownish and bituminous shales and marls in the Great Oolite provide a further distinguishing characteristic.

K. GREAT OOLITE SERIES, 4541' - 4737' (196 feet thick)

The top of the Great Oolite Series is marked by fine-grained limestone and brown marl, with small quantities of bituminous shale (4541' - 50'). The limestone at this level and below is mostly finely recrystallised in the matrix; although included shell fragments are largely unchanged. The next six feet is an oolitic limestone, and the interval 4556 - 73' grey, brown and buff marl. Beneath is 27' of brown and grey marls and oolitic limestone together with sandy limestones (to 4600'), the latter suggesting a "Forest Marble" facies. Mainly shaley beds with minor oolitic limestones continue to 4641', and in the interval to 4686' oolitic marls occur with shaley beds and more limestones. This group may well correlate with the supposed "Hampen Marly Beds" at 4424 - 80' in Portsdown No. 1 well. Whitish and grey oolite, partly shelly, partly recrystallised at 4686' - 4713' may represent the Taynton Stone of Portsdown, with the 24' of somewhat sandy limestones beneath as "Passage Beds". The latter yielded Ostrea fragments (4695 - 8') occasional Rhynchonella, and included a little calcareous sandstone at the base.

On the whole this sequence is appreciably more shaley and marly than that of either Portsdown, Henfield or the Cotswolds, and the beds must have been laid down in a relatively muddy sea. It is possible that the well known absence of Great Oolite in South Dorset was associated with uplift and erosion of early Jurassic days nearer the margin of the basin, and that products of denudation from (say) the Lias were carried eastwards towards the Isle of Wight.

L. FULLER'S EARTH, 4737' - 4989' (152 feet thick)

The upper part of the Fuller's Earth is developed as greyish shale and marl, with rare shells,(e.g. "Avicula" at 4740'). Twelve feet down (4749' - 58') Ostrea fragments become common in the cuttings, and a piece of a fine-ribbed Rhynchonella was found. This horizon might possibly correlate with the boueti bed of the Dorset coast. Limestone (fine grained, slightly sandy) is present in minor quantities down to 4776', but represents half the bulk or more of recovered samples from there to 4812'. Occasional fragments of Rhynchonella and Ostrea were found throughout this interval; Ostrea was particularly common in a greenish limestone at 4785 - 8', and a small belemnite was noted at 4803'. It is likely that this interval (4776' - 4812') represents the Fuller's Earth Rock of the outcrop - a bed which was absent at Portsdown but present at Henfield.

Beneath the limestones was 69 feet of grey and brownish shale, slightly silty or finely sandy in part, with only slight traces of limestone (4812' - 4981'). A few Rhynchonella occurred from 4946' - 4971', together with a young Ornithellid. A core was taken from the base of these shales, which were barren except for an obscure crushed ammonite which Dr. Arkell was unable to identify; it could have been a Seimiradzskia (as at Portsdown at this level) but was too poorly preserved for certainty.

Beneath were shelly and marly irregular limestones, locally pyritic, which yielded an interesting fauna. Lamellibranchs included Syncyclonema and "Goniomya v-scripta", while Dr. H.M. Muir-Wood identified Sphaeroidothyris sp., Rhactorhynchia sp., Aulacothyris cf. cucullata and Acanthothiris midfordensis (see Appendix D). This fauna is considered by Dr. Muir-Wood to indicate basal Fuller's Earth, about fusca zone, so these limestones have to be excluded from the Inferior Oolite and the formational boundary taken at the base of the next shale parting down - at 4989'. A limestone development at this level adds another case to the known irregularity in horizon of hard beds in the Fuller's Earth.

The overall thickness of the group (152 feet) is half as much again as at Portsdown (where the Fuller's Earth rock is absent), but only a little thicker than at Henfield.

M. INFERIOR OOLITE, 4989' - 5161' (bottom), 172 feet, incomplete.

The uppermost 90' of Inferior Oolite consisted of dense crystalline limestones, frequently mottled in appearance, with occasional shell fragments. An iron mineral tentatively identified as chalybite occurs throughout. From about 5058' to 5067' the samples showed a little dark grey and brownish shale and marl, presumably interbedded with the limestones.

At 5079' the hole entered limestones which were slightly sandy and contained glauconite? grains, about 12 feet in thickness (to 5091'). Beneath this were 40 feet of slightly sandy crystalline limestone with bluish chert nodules which provided difficult drilling conditions. This group (5091' - 5030') may confidently be correlated with the false-bedded chert-bearing limestones of the Middle Inferior Oolite at Portsdown No. 1 (4840' - 4875'), for chert horizons are a rarity in the Jurassic series and it is unlikely that two different horizons are represented.

The lowest beds reached were grey crystalline limestones, slightly sandy and limonitic, thinly bedded in the final core. It is possible that these beds are the equivalent of the sandy false bedded limestones which make up the top of the Lower Inferior Oolite at Portsdown.

6. GENERAL CONCLUSIONS.

The consistent horisontality of the beds in the well shows that it was accurately located on the crest of the Arreton structure, and although it is crestally lower than the less accessible Brook Bay and Sandown anticlines it still seems a sufficiently good structure to have trapped some oil if other conditions were favourable.

Since reservoir conditions although not particularly good were adequate to contain fluids (the open cavities in the Corallian limestones are an example) the lack of evidence of oil other than minute traces has to be explained by the past history, which may be in part deduced from the stratigraphic column.

Despite previous indications from gravity surveys, Arreton is now known to share with Portsdown, Henfield, Kingsclere and other deep tests a position well down in the Jurassic basin, and it is quite possible that contemporary gradients were sufficient to encourage movement of oil towards the marginal parts such as Dorset.

There is in addition some evidence of local complexities in the history of movement. The abnormally thick Kellaways development provides a suspicion that there may have been an early shallowing of the Jurassic basin not far from Arreton, possibly even beneath the southerly part of the I.O.W. At a higher level the derived Kimmeridge ammonites in the basal Aptian at Sandown, a block of derived Kimmeridge shale in the same beds at Shanklin and of probable Portlandian cherts in the Ferruginous Sands inland, point to an important phase of earth movement in the district in Lower Cretaceous times, a movement which evidently produced a "high" subject to erosion at no great distance. If we could locate this high it might have significant oil prospects despite the unfavourable result of Arreton No. 1, for it represents a relative uplift of the order of 2,500 feet. Our present methods are however doubtfully adequate for the search, and it may in any case lie under the sea.

Meanwhile it seems logical to continue exploration for trapped Jurassic and Lower Cretaceous oil near the margins of the contemporary basin, and the result of Arreton No. 1 tends to emphasise rather than reduce the importance of continuing with the exploration of Dorset.

(Sgd.) R.G. MacLean.

Ealing
14th August 1953.

APPENDIX A.

HISTORY OF DRILLING OPERATIONS AND MUD CONTROL

(a) STAFF

Drilling Superintendent		J.M. Gibson
Tool Pusher		S.A. Ray
Resident Geologist	1)	A.E. Pedder
	2)	R.G. Maclean
Resident Petroleum Engineer	1)	G.W.E. Paddock
	2)	M.M. Pennell
Mud Engineer		J.H. Edwards

(b) WELL HISTORY

(i) Monthly Footage

1952	October	291 feet
	November	1544
	December	446
1953	January	512
	February	1161
	March	929
	April	278

(ii) Operations

A 136-foot derrick with Ideal 50 drawworks powered by two 200 h.p. Paxman Diesels was used. One National C.250 and one C.150 pump were installed for circulating and mixing mud.

The well was spudded on October 12th and 18-inch hole drilled to 226 feet. The hole was reamed to 19 inches and drilling at this diameter continued to 291 feet. After a short delay necessitated by re-reaming the hole the 16-inch casing was run and cemented with the shoe at 285 ft. on October 29th using 9 tons of cement.

Drilling was resumed on November 3rd and a $14\frac{3}{4}$" hole drilled to 2256 ft. Metal was suspected in the hole at 2246 ft. but none was recovered after running a magnet and making two trips with a Globe Basket bit. Schlumberger surveys were made on December 13th and 14th prior to running and cementing $11\frac{3}{4}$" casing with the shoe at 2250 ft.

$10\frac{5}{8}$" drilling commenced on December 28th. $7\frac{3}{4}$" cores were taken from 2314' - 2377', 2416' - 2601', 3733' - 3769' and 3826' - 3987' necessitating subsequent reaming to $10\frac{5}{8}$". After a Packer test of the interval 3866' - 3921', heavy caving occurred in the $7\frac{3}{4}$" pilot hole (top 3733'), from 3816' to 3829'. The pilot hole was therefore reamed out from 3733' to 3910' using a $10\frac{5}{8}$" Security Reamer and much of the open hole had to be cleaned from the shoe. Heavy cavings were encountered particularly from 3596' - 3692' (Kimmeridge) and 3816' - 3825' (Corallian - Sandsfoot clay). These were gradually eliminated by cleaning and allowing the gel strength of the mud to rise. Subsequently when reaming the $7\frac{3}{4}$" pilot hole from 3910' - 3987' to $10\frac{5}{8}$" it was also necessary to ream and re-ream the hole from 3781' to bottom. The $10\frac{5}{8}$" hole was drilled to 4008'.

From 4008' drilling continued through the Oxford Clay to 4431' using $8\frac{5}{8}$" bits.

From 4431' to the bottom, the hole was drilled at 7⅞" diameter and cores were taken from 4431' - 4512', 2975' - 4990' and 5150' - 5161'. Below 5040' the formation became harder. An OSQ2 bit was pulled out from 5097' after 30 hours on bottom with 48 rollers missing, its teeth worn away completely and its overall diameter reduced to 6½". The bottom of the hole was reamed to 7⅞" diameter. A 7" magnet was run to bottom but only recovered 2 rollers and some small junk. A calyx basket was then run and 44 of the remaining 46 rollers were recovered. Thereafter W7R bits were used until operation ceased.

Schlumberger and Well Velocity surveys were made before cementing off. Dismantling began on April 30th.

(iii) Operational Summary

The following is a rough break down of working time:-

Footage recorded on	148 days
Casing hole	12 days
Enlarging hole	10 days
Installing plant	3 days
Repairs	3 days
Reaming and cleaning hole	2 days
Packer Tests	2 days
Schlumberger Surveys	1 day
Fishing	1 day

Total working days, 12th Oct.-19th April - 182

(c) DRILLING FLUIDS

Throughout drilling operations, a fresh water/bentonite/shale mud of average S.G. 1.24 was used.

For spudding in and drilling through the Lower Greensand a Fresh water/Gault clay/Bentonite mud was used. Gravity and viscosity were controlled by continuous addition of water. No other treatment was required and the mud had excellent properties. Only slight losses were experienced in the Lower Greensand. Average properties of the mud in this formation were:-

S.G.	1.24
Viscosity (A.P.I.)	34.5
Filtrate (½ hour)	10.5 c.c.
Cake	2/32"
pH.	8.0

After drilling the cement from the 16" casing the mud was changed. Until the cementation of the 11¾" casing the mud consisted essentially of absorbed solids of the Wealden clay, and remained in good condition. Water for weight and viscosity control was the only additive.

S.G.	1.27
Viscosity	34.5
Filtrate	9 c.c.
Cake	2/32"
pH.	9.95

In his monthly report for March, the Mud Engineer (J.H. Edwards) drew attention to the fine dispersion and plastic properties of the Wealden Clays and their likeness to the hydrous mica or Illite group of clay minerals.

Traces of mica occurred in the samples. In addition to this, no sources of contamination were encountered such as Chlorides or Calcium salts, and finely dispersed drilled lignite seems to have had some thinning effect on the mud. The overall effect of these conditions produced a mud of low water-loss combined with good fluidity and desirable thixotropic characteristics.

After drilling out the residual cement in the 11¾" casing, the mud used for drilling ahead in the Purbeck and Portland was a mixture of reserve stock and pre-hydrated bentonite. Initially the mud had a high viscosity but responded well to quebracho treatment (2½ lbs./100 cu.ft.) giving a mud with these properties:-

S.G.	1.13
Viscosity	31 secs (A.P.I.)
Filtrate	15 c.c. in ½ hour
Cake	2/32"
pH.	9.5 - 10

On encountering the Purbeck anhydrites there was an undesirable increase in viscosity and gel strength that had to be combated constantly during coring and subsequent reaming operations. This was done by additions of calgon and quebracho thinning agents and soda ash was added to precipitate dissolved calcium. However, large additions of soda ash had to be avoided since a product of its addition when anhydrite is present is sodium sulphate, a cause of the increased gel strength. Hence it was only added along with calgon or quebracho or sometimes both. Initially only the viscosity and gel were affected when anhydrite was encountered, but as more calcium ions replaced sodium ions in the clay particles, the water loss gradually increased from 12.5 to 19 c.c. The viscosity frequently rose to over 40 secs. and on one occasion 57 secs. was recorded.

In the Portland, the mud properties were kept fairly constant by small additions of soda ash and calgon and had the following properties

S.G.	1.15 - 1.16
Viscosity	35
Filtrate	20
Cake	3
pH.	8 - 8.5

On entering the Kimmeridge Clay, the mud began to absorb solids from the formation resulting in gravity and viscosity increases. This was checked by adding water and calgon. There was also a gradual increase in water loss and salinity. The following average characteristics were maintained.

S.G.	1.24
Viscosity	36 secs.
Filtrate	16.5 - 21 c.c.
Cake	3/32
pH.	8 - 8.5
Sal.	675 - 1770 p.p.m. chloride.

These properties were maintained until operations ceased. In the more calcareous zones (Corallian, Great Oolite and Inferior Oolite) where less solids were absorbed from the formation, bentonite treatment was possible and resulted in reduced water loss. Calgon was used as a thinning agent to about 4100 feet but thereafter quebracho proved more effective and was exclusively used.

A high gel-strength mud was prepared for plugging the well by adding soda ash to a viscous mud from storage, originally prepared to use in the event of serious mud loss. This was pumped to the hole between slugs of cement.

APPENDIX B

CORE ANALYSES

The following table summarises the data from cores obtained by the Petroleum Engineers resident at Arreton (Messrs. Paddock and Pennell) in the mobile core laboratory on site.

Depth	Rock Type	POROSITY %			Perm. m.ds.	Formation Factor	SALINITY in p.p.m.	REMARKS
		Air	Brine	Extract				
1836	Sst.	23	24.9		92.4	13.4		
1837½	"	5.9	4.8		64.5	116		
1839¼	"	5.7	5.5		0.2	117		
2248⅓	Lst.	2.5	1.6		Nil	377		
2314⅓	"	3.8	4.6	2.2	Nil	180	32,000	
2316⅓	Shale	10.7		9.6	Nil		7,200	Plug broke in brine
2320	Lst.	1.4	0.9	0.9	Nil	396	14,300	
2324¼	"	5.0	4.0	3.4	Nil	78	10,350	
2326	"	4.0	2.8	2.4	Nil	123	13,900	
2331¾	"	4.2	3.5	4.9	Nil	156	31,100	
2334	"	2.4	3.3	2.7	Nil	167	31,100	
2336¼	"	3.4	4.5	2.3	Nil	106	21,800	
2340¼	"	4.7	3.8	2.7	Nil	122	13,900	
2343¼	Shaley Lst.	1.7	3.2	3.7	Nil	212	11,750	
2348¾	Lst.	1.9	3.8	5.0	Nil	233	13,900	
2352¾	"	3.5	2.8	4.4	Nil		17,150	
2355¾	"	4.9	6.9	8.8	Nil	61	16,900	
2358½	"	4.8	6.2	7.2	Nil	117	19,900	
2360¾	"	6.3	7.6	6.9	Nil	78	21,200	
2369¾	Shaley Lst.			16.8			12,200	Plug broke while drying.
2374½	"			9.9			10,800	- do -
2377	"			6.6			12,300	- do -
2417½	Anhydrite	0.1		0.3	Nil	216	26,700	
2422½	" lst.	5.4	4.3	1.5	Nil	80	61,800	
2433	Lst.	5.5	5.0	1.8	Nil	121	95,000	
2437¼	Anhydc. lst.	1.9		0.5	Nil	216	80,000	

Depth	Rock Type	POROSITY %			Perm. m.ds.	Formation Factor	SALINITY in p.p.m.	REMARKS
		Air	Brine	Extract				
2444½	Lst.	7.5	5.8	2.3	Nil	121	151,500	
2460	"	4.6	3.8	1.7	Nil	165	44,100	
2470	Anhydc. lst.	2.9	2.5	1.4	Nil	162	67,500	
2480	Calc. shale	11.6	12.1	5.5	1.6	39	90,800	
2489	Shaley Marl			7.1			49,600	Plug broke while cutting
2499	Anhydc. lst.	5.1	3.1	2.2	Nil	244	88,600	
2509	Lst.	1.0	1.7	1.3	Nil	929	80,000	
2519	Shale	2.6		6.3	Nil	86	50,200	Plug broke in brine
2529	Anhydrite	3.2		0.5	Nil	363	56,000	
2539	"	1.2		0.3	Nil	197	66,800	
2549	"			0.2	Nil		100,000	No plug.
2560.5	Lst. (oily)			4.1				No plug. Oil content .7%
2561¼	Anhydrite	Nil		0.2	Nil	121	60,000	
2562¾	" lst.	0.4		0.4	Nil	686	96,000	
2569	Lst.	3.2	2.7	2.8	Nil	133	61,400	
2574	"	5.4	3.9		Nil	150		Toluene extraction spoilt.
2579	"	5.0	4.1	9.1	Nil	135	79,000	
2586	"	7.3	7.6		Nil	60		No Toluene extraction
2597		7.0	7.4	3.7	Nil	115	155,800	
3747	Shale			13.2			37,300	No plug
3826	Lst.	3.3	1.4	2.6	Nil	245	48,300	
3833	"	3.8	2.0	2.0	Nil	230	59,200	
3848	"	3.0	1.6	1.8	Nil	337	47,100	
3869	Oolitic lst.	2.9	2.7	2.6	Nil	161	48,300	
3870½	"	2.6	2.7	2.4	Nil	186	52,700	
3883	"	2.3	2.3	2.9	Nil	222	56,600	
3890	"	4.1	2.8	2.9	Nil	176	48,300	
3900	"	1.7	2.0	2.2	Nil	304	59,000	
3902	"	2.5	2.5	4.5	Nil	165	42,400	

Depth	Rock Type	POROSITY %			Perm. m.ds.	Formation Factor	SALINITY in p.p.m.	REMARKS
		Air	Brine	Extract				
3912	Gritty lst.	5.3	3.8	8.0	Nil	117	65,800	
3921	"	10.0	7.5	7.9	Nil	72	71,600	
3937	Shale	-	-	13.3		-	25,700	No plug.
3956	Shelly shaley lst.	3.0	6.2	6.5	Nil	97	40,400	
3960	Lst.	5.6	3.2	2.4	.08	124	31,900	
3963	"	3.3	2.3	2.0	Nil	204	26,000	
3977	Marl	10.0	8.0	8.9	1.7	69	34,000	
3982	-	-	-	10.9	-	-	32,000	Plug broke
4435	Silty Shale	-	-	6.7	-	-	34,600	No plug
4441	Shelly lst.	5.7	5.7	5.8	1.4	55	38,000	
4451	Shelly mly. lst.	9.7	7.2	7.5			31,700	
4456	Lst.	7.9	7.5	8.1	Nil	49	66,800	Salinity high as result of boiling over
4462	Marly lst.	9.2	9.0	7.1	Nil	32	47,800	
4470	Sandy marl	10.7	8.0	6.7	2.9	37	42,700	
4474	Sandy marl lst.	10.3	9.0	7.5	0.8	47	34,300	
4480	"	15.0	9.0	8.0	0.8	41	33,800	
4499	Shelly shale	1.5		5.8	Nil		29,900	Plug broke in brine
4508	Shelly marl	2.0	3.4	3.1	Nil	175	30,000	
4976	Marl	2.1	-	3.8	Nil	-	24,800	Plug broke in brine
4981	Mly. shelly lst.	3.1	3.2	3.3	Nil	134	27,100	
4985	Marly lst.	1.6	2.9	3.0	Nil	306	38,100	
5151	Lst.	2.4	2.3	2.5	Nil	204	26,100	
5156	Marly lst.	-	-	3.4	Nil	-	30,100	Plug broke.

Appendix C.

Well Surveys in Arreton No. 1 Borehole.

With Graphic Comparison between Geological and Gamma Ray Logs (including data from Electric and S.P. Logs) (in 3 sheets).

A. General.

The surveys carried out in this borehole were as follows:-

1. Gamma ray log.

2. Electric logs.

(i) Normal logs (a) 32" and 64" with S.P. log. Done only to 2250' and repeated on expanded scale.

(b) 16" and 64" and S.P. log.

(ii) Lateral logs, (a) 56" and S.P. log.
(b) 224" and S.P. (only to 2250')

(iii) Fluid resistivity log.

3. Caliper log.

4. Well Velocity Survey.

The borehole was surveyed in two parts (a) down to 2250' prior to running 11.3/4" casing and (b) from casing shoe to final depth 5161'.

The technical results are given in two Technical Notes issued by Kirklington Hall and the relevant references are as follows:-

(i) TN 176/53 9th February, 1953.

(ii) TN 184/53 5th June, 1953.

B. Basis of Interpretation of the Logs.

One way to show the results of these surveys is by means of correlated columns with a final column (interpretation column) showing the type of rock which most nearly fits the physical data presented by the logs. Ideally this should be compared with the geological graphic log as drawn up on sample evidence and a final column should then show an accurate rock section as penetrated by the drill.

In this Appendix, an "interpretation-log" is shown compared with the geological log and by their comparison the depth discrepancies at rock interfaces located by the logs and samples are then discernible.

The gamma ray log is drawn in detail on the left hand side of the diagrams and is shown as the log with the greatest general interest. The finer details of the interpretation column have been inserted using all the available data.

C. Geological Interpretation.

1. Lower Greensand. Normal low gamma activity is recorded in these sandstones from surface to 130' but higher (almost to shale level) is recorded between 130' and 170'. This is due to glauconite in the basal part of the sandstones. A shift in the base-line occurs between

Contd...

280' and 290' and this coincides with the base of the Lower Greensand on other evidence, it may, however, be due to the presence of 16" casing shoe.

2. The Wealden Beds. The succession consists of a group of variegated marls, clays and shales with sandstones at intervals. The succession is extremely well shown by the S.P. log, and is confirmed by the electric logs and gamma ray log. The caliper log showed that most of the sandier zones were located in oversize hole. These were saturated with saline water but small saturations of oil or gas could conceivably have been present and remained undetected on the resistivity logs. Agreement with the geological graphic log is fair to good.

3. Purbeck. The Normal and Lateral Logs give the best detail through these beds; both the S.P. and the gamma-ray log are somewhat featureless. The agreement with the geological log is closest when the succession has been cored. The Lower Purbeck anhydrites are particularly well shown as zones of low activity and high resistivity.

4. Portland. The electric logs again give the best detail through this type of succession which shows only as a general zone of low activity on the gamma-ray log. A shale between the Purbeck basal anhydrite and the Portland Limestone is, however, best shown by the gamma-ray log.

5. Kimmeridge Clay. The more calcareous portions, cementstones etc. of this monotonous clay succession have a lower gamma count than the clays and at 2925' one of these bands shows a peak on the S.P. which may indicate that it has some porosity. The electric logs are otherwise rather featureless but even small deflections appear to be consistent throughout. It is impossible to say what these mean. Two limestones near the base of the clay are well seen on the gamma log but are poorly indicated on the electric logs. There is no porosity in these beds.

6. Corallian. The top of the oolitic limestone series is well shown by all logs; the overlying sandy shaly series has the same characters as the Kimmeridge above and are not differentiated from it. The limestone succession was cored and there is fair to good agreement between the geological and Schlumberger logs.

The Corallian was one of the main objectives of the borehole and the following remarks can be made on the nature of its reservoir characteristics. The limestone from 3913'-31' is sandy and is shown only by the S.P. log. The lack of symmetry of this curve would indicate that the shale content increases towards the base. The apparent resistivity values are low for a calcareous formation, and suggest that the available pore-spare is filled with brine. The major limestone group lies between 3829' and 3905' and of this interval, the upper half only appears to have permeability. The interval tested (3866-3921) is in the least permeable part of the succession. The basal limestone appears to have a low resistivity and this would suggest the shale content is larger than the limestone.

7. Oxford Clay. The uniformity of this succession is indicated by all the logs; the whole zone is completely impervious. The beds have an average gamma-count throughout, and apart from slight changes in resistivity (e.g. at 4140' and 4400') the electric logs are featureless.

8. Kellaways Rock. These beds are similar to the Oxford Clay in their physical characters and, with the exception of a calcareous sandstone near the middle, are equally impervious.

9. Cornbrash/Great Oolite Series. Lithologically it is not possible to separate these beds both consisting as they do of thin limestones in shales and marls. All the beds appear to be equally impervious. At 4699' a change in activity-level marks the top of the limestone near the base.

Contd....

10. Fullers Earth. The limestones developed in the upper part of these beds occur much more closely spaced on the geological log than is shown by the Schlumberger logs. All the beds are, however, impervious. The basal limestone is not well shown on the gamma-ray log and is therefore somewhat argillaceous.

11. Inferior Oolites. Apart from some shaly bands near the top, this group consists entirely of limestones. A low gamma-count is interrupted at 5095 by a higher activity band which is correlated with the presence of the glauconite seen in the samples. Two permeable zones are shown by the S.P. curve at 5023' and 5097'; the upper of these is divided by the normal log into a lower more permeable zone and an upper less permeable zone.

The sandier nature of the limestones below 5100' may be reflected in the negative SP. deflection recorded from here to the bottom of the hole. The gamma count is low throughout.

D. Other Logs.

1. Borehole Fluid Resistivity log. This log has no geological significance and is taken for the interpretation of the electric logs.

2. Caliper log. From the bottom of the 16" casing (285) to 2250' the Calipers were run twice and there was no significant difference between the two logs. These logs gave the mean diameter of the borehole as being between 16" and 20". The nominal size was 14.3/4" and this figure was seldom approached; the larger sized hole can be correlated with the sandier parts of the sequence.

E. Conclusions.

1. A complete set of Schlumberger logs and the graphic log give an accurate record of the strata penetrated.

2. No significant hydrocarbon accumulations have been indicated by Schlumberger logging.

3. The only permeable and resistive zones in the borehole lie in the Portland the Corallian and the Inferior Oolites. The Purbeck Limestones are less attractive as reservoirs.

4. High resistivities can often be shown as being due to the tightness of the formation; from the logs the presence of non-conductive fluids would be regarded as unlikely.

W.D.V. JONES.

Eakring
16.11.53.

Appendix C

Arreton No. 1.

Well Velocity Survey.

The survey was carried out on the 22nd and 23rd of April 1952, the positioning of the well-geophone being undertaken by the Kirklington Hall Schlumberger Group. Six shot holes were drilled in advance of the survey down to sea-level and six shots were fired from each hole.

The inner holes were used for depths (of well geophone) down to 3830' and the outer holes from there to the bottom of the hole. An observation at 3830' was made from each shot point.

The main results of the survey may be summarized in the following table showing the interval velocities found:-

Wealden	8900	feet/sec.
Purbeck & Portland	13450	" "
Kimmeridge	10200	" "
Corallian	11100	" "
Oxford Clay & Kellaways	12030	" "
Oolite Series	15300	" "

A further aspect of the work was then considered. Two previous reports had dealt with a reflection survey covering the area (U.K.166 and K.H.G.22), the last being concerned with the possibility of confusion in the results due to multiple reflections.

A seismic record was considered in conjunction with velocities obtained and the reflecting horizon determined. A list of these follows with depth:-

1. 1155 Sandstone in Wealden Series.
2. 1575 " " " "
3. 2035 " " " "
4. 2380 Purbeck Marl/Limestone interface.
5. 2650 Portland/Kimmeridge Clay interface.
6. 3075 Calcareous band (of cementstone type) in Kimmeridge Clay.
7. 3750 Kimmeridge Clay/Corallian interface.
8. 3975 Corallian/Oxford Clay interface.
9. 4520 Kellaways Rock/Cornbrash interface.
10. From below the bottom of the hole at an interface probably between the Oolites and Lias Clays Series.

As these reflections have been fitted into the strata reasonably well, the number of possible multiple reflections has been greatly reduced by the well velocity survey.

W.D.V. JONES.

APPENDIX D - PALAEONTOLOGY

D(i) REPORT ON JURASSIC BRACHIOPODA FROM ARRETON, ISLE OF WIGHT.
by H.M. Muir-Wood, D.Sc., F.G.S.

I have at last found time to look at your specimens which at first glance appeared to be wattonensis - Beds from their tough dark limestone matrix. However, a closer examination soon disposed of that idea. The assemblage is not easy to place, and is not identical with anything I have previously seen.

There are no specimens of Wattonithyris or Rhynchonelloidella, the two commonest fossils of the Fullers Earth Rock, and there are also no Ornithellids or Rugitelas. I have therefore ruled out F.E. Rock altogether. At the same time there are no large globose Sphaeroidothyrids which occur so commonly in the Upper Inferior Oolite, truellei or zigzag zone of Dorset. There are numerous smaller Sphaeroidothyrids and a more narrow form which resembles my species S. pentagonalis from the Lower Fullers Earth, from about fusca zone of Dorset. The small forms which are imperfectly preserved might be comparable with the small Sphaeroidothyris or Tubithyris sp. which occur in the Lower Fullers Earth knorri clay of Doulting, Somerset and described by Richardson and Walker in Q.J.G.S. LXIII, 1907. A slightly larger form might be an elongate specimen of S. lenthayensis R.& W. which occurs just above zigzag zone in the fusca zone of Dorset.

The small Acanthothiris is comparable to A. midfordensis R.& W. from the Lower Fullers Earth knorri Clay of Doulting, Somerset, and from other localities from the same horizon.

The horizon is therefore I think about fusca zone of Dorset and knorri clay of Somerset. I have attached a list of identifications from the various levels, and regret that I cannot give you more precise information.

No. of Specimens	Depth	Identifications.
1	4980'	Terebratulid lacking umbo. It appears to be slightly uniplicate and may be a Tubithyris sp.
1	4981'	Sphaeroidothyris sp., a number of small spheroidal specimens, and two larger specimens rather crushed; might be S. pentagonalis M.-W
3	4982'	Two Terebratulid fragments. One Sphaeroidothyris sp., ? pentagonalis M.- W showing muscle scars.
2	4982½'	Sphaeroidothyris sp., either young forms or small species like that occurring in Lr. F.E., knorri- Clay of Doulting, Somerset. Aulacothyris cf. cucullata SS. Buckman, imperfect specimen but seems to be nearer this species from zigzag or fusca zone of Dorset than A.cf. mandelslohi (Oppel) which occurs in the Knorri Clay of Doulting. Sphaeroidothyris sp. cf. pentagonalis Muir-Wood, narrow elongate form preserved as internal cast showing typical muscle scars. S. pentagonalis occurs in the Lr. Fullers Earth of Dorset, at one locality 10' above zigzag Bed, and in another just above 'The Scroff' = fusca zone.
1	4983'	Sphaeroidothyris sp., small elongate form. Rhynchonellid fragment, possibly of a Rhactorhynchia sp. Species of Rhactorhyncia occur in the Lr. F.E., knorri clay at Doulting, Somerset, and at Haselbury, Dorset.
2	4984'	Acanthothiris midfordensis R.W., fragments of four specimens. This species was described originally from the knorri Clay of Doulting, and Midford, Somerset.
2	4985'	Acanthothiris midfordensis Richardson & Walker. One entire and one fragmentary specimen.

This assemblage and more especially the presence of an Aulacothyris cf. cucullata and Acanthothiris midfordensis are thought to indicate Lower Fullers Earth, about fusca zone.

APPENDIX D (ii) : OSTRACODS

First Report on the Arreton No. 1 Well, Isle of Wight.

by F.W. Anderson, D.Sc., F.R.S.E., F.G.S.

In general the samples contained few fossils and most of those recovered were poorly preserved or fragmentary. The microfauna was, however, sufficient to make it certain that in the Wealden the zonal sequence of the Weald applies. In the Purbeck, direct comparison with the succession at Durlston Bay to the west and at Portsdown to the east was possible. In the Kimeridge Clay too few specimens were found for any zonal subdivision to be possible but it appears that the zonal scheme adopted in Germany does not apply.

LOWER GREENSAND

0.130 ft.	Sands and sandstones. No fossils seen.
130-170 ft.	Sandy clays. Indeterminate ostracods in sample 160-165 ft.
170-205 ft.	Mainly clay. No micro-fossils seen.
205-210 ft.	Muddy sandstones with shell fragments, fish remains, indeterminate ostracods and foraminifera.

WEALDEN

The dark grey clays between 210 ft. and 280 ft. are thought to lie at the top of the Wealden. Only a few fragmentary ostracods were recovered but the genus Cypridea s.l. is undoubtedly represented and the species appear to be the un-ornamented forms of Cypridea (Morinina) dorsispinata Anderson and Cypridea (Morinina) spinigera (Sowerby) which are characteristic of the uppermost beds of the Wealden at Punfield.

Evidence for six out of the nine Wealden zones has been obtained though in no case can the zonal boundaries be accurately determined. The subdivisions have, however, been roughly estimated. In every case it is clear that the thicknesses of the zones at Arreton are much greater than in the Weald.

In general, ostracods are confined to the grey shales. The variegated marls are practically unfossiliferous and the dominance of this type of deposit accounts for the great difference between the rich fauna of the Weald and the paucity of ostracods at Arreton.

ZONE XIV (Zone of Metacypris berwickensis). 210-320 ft.

Grey shales and clays with a thin limestone at 280 ft. Ostracods few except for a rich band at 285-295 ft.

Cypridea (Cyamocypris) valdensis (Fitton)
" (Morinina) dorsispinata Anderson, var.
" " spinigera (Sowerby)
" " " " var.
Candona or Cypris app.
Metacypris fittoni (Mantell)
" berwickensis (Martin)

ZONE XIII. (Zone of Cypridea clavata), 320-800 ft.

Top 55 ft. consists of sandy shales and marls with fish, shell and plant fragments and some ostracods:-

Cypridea (Tuberocypridea) clavata Anderson
" (Cyamocypris) valdensis (Fitton)
Metacypris berwickensis (Martin)
Candona sp. ?

The remainder of this thick zone, consisting mainly of variegated clays and marls, is practically unfossiliferous though indeterminable ostracod fragments were found at one or two levels.

ZONE XII. (Zone of Myocythereis henfieldensis), 800-950 ft.

Variegated clays and marls, sandy in the middle of the zone. Sample 825-830 ft. contained the zone fossil, M. henfieldensis (Anderson).

ZONE XI. (Zone of Cypridea dorsispinata), 950-1050 ft.

Variegated clays and marls, sandy in the middle of the zone. No ostracods seen.

ZONE X. (Zone of Cypridea tuberculata), 1050-1350 ft.

Variegated marls and sands. Fragmentary and indeterminable ostracods in sample 1320-25 ft.

ZONE IX. (Zone of Cypridea spinigera) 1350-1550 ft.

Sandstones and variegated marls. Sample 1390-95 ft. contained:-

Cypridea (Pseudocypridina) laevigata (Dunker)
Metacypris berwickensis (Martin)

C. laevigata was common in this zone in Portsdown No. 1 Well

ZONE VIII. (Zone of Cypridea paulsgrovensis), 1550-1850 ft.

Variegated clays and sands. Indeterminable ostracods found in samples 1700-05 ft., 1710-15 ft., 1720-25 ft., 1730-35 ft., and 1735-40 ft. In sample 1765-70 ft., the following were recognised:-

Cypridea (Orthocypridea) paulsgrovensis (Anderson)
Darwinula leguminella (Forbes)

C. paulsgrovensis is characteristic of this zone and in the Portsdown No. 1 Well is very abundant at this horizon.

ZONE VII. (Zone of Cypridea menevensis), 1850-2100 ft.

Variegated clays and sandstones. Occasional fish fragments seen but no ostracods.

ZONE VI. (Zone of Cypridea dolabrata), 2100-2190 ft.

Grey clays and marls with Chara gyrogonites and ostracods as under:-

Cypridea (Pseudocypridina) dolabrata (Anderson)
" " laevigata (Dunker)
" " paulsgrovensis (Anderson)
Cypridea (Cyamocypris) austeni Jones
" (Morinina) triangularis MS
" (Orthocypridea) simplex MS
Metacypris fittoni (Mantell)
Darwinula oblonga (Roemer)

The zone fossil C. dolabrata is common. The first three species in this list are very characteristic of the zone especially in the Kingsclere No.1 Well.

The base of the Wealden is taken at 2190 ft. since sample 2190-95 ft. contains Cypridea setina rectidorsata, a species not known to occur in the Wealden elsewhere.

PURBECK

Upper Purbeck

ZONE V. (Zone of Cypridea setina), 2190-2250 ft.

Grey marls and limestones containing the following ostracods:-

Cypridea (Pseudocypridina) dolabrata (Anderson)
" " laevigata (Dunker)
" " setina setina (Anderson) +
" " setina rectidorsata (Bradley) +
" (Tuberocypridea) aculeata Jones
" " verrusoca Jones
" (Cyamocypris) austeni Jones
" " menevensis (Anderson) +
" (Orthocypridea) brevirostrata Martin
" " paulsgrovensis (Anderson)
" " simplex MS

Cypridea (Orthocypridea) varians MS
" (Cypridea) propunctata Bradley +
Darwinula leguminella (Forbes) +
" oblonga (Roemer)
Scabriculocypris pygmaea MS

The species marked thus + are especially characteristic of this zone.

Middle Purbeck

ZONE IV. (Zone of Cypridea propunctata), 2250-2300 ft.

Limestones and shales with:-

Cypridea (Cyamocypris.) austeni Jones
" " menevensis (Anderson)
" (Pseudocypridina) laevigata (Dunker)
" " setina setina (Anderson)
" " setina rectidorsata Bradley
" (Orthocypridea) lata Martin
" " paulsgrovensis (Anderson)
" " varians MS
" " ventrosa Jones
" (Cypridea) propunctata Bradley
" (Tuberocypridea) aculeata Jones
Gomphocythere silvana Martin
" striata Martin
Metacypris forbesii Jones
Darwinula leguminella (Forbes)
" oblonga (Roemer)

This assemblage is similar to that found in Zone V except for the presence of the brackish water forms Gomphocythere silvana and G. striata and Metacypris forbesii. The rather rare Cypridea lata is also characteristic of this zone.

ZONE III. (Zone of Cypridea granulosa) 2300-2372 ft.

Limestones and shales with:-

Cypridea (Cypridea) fasciculata (Forbes)
" " granulosa (Sowerby)
" " protogranulosa MS
" (Pseudocypridina) posticalis Jones
" (Cyamocypris) acrobeles MS
" " austeni Jones
" (Orthocypridea) simplex MS
Macrodentina retirugata (Jones)
Allocythereis radiata MS
Scabriculocypris ovalis MS
Darwinula leguminella (Forbes)
" oblonga (Roemer)

Cypridea fasciculata and C. granulosa are peculiar to this zone and Cypridea posticalis, Allocythereis radiata and Scabriculocypris ovalis are characteristic forms.

Lower Purbeck

ZONE II. (Zone of Neocytheridea bononiensis), 2372-2450 ft.

Shales, marls and limestones with some anhydrite.

An assemblage of ostracods quite typical of the zone:-

Cypridea (Cyamocypris) acrobeles MS
Bairdiocypris purbeckensis (Forbes)
Neocytheridea ansata (Jones)
" bononiensis (Jones)
Scabriculocypris ovalia MS
Macrocypris horatiana Jones and Sherborn

The fauna is entirely dominated by N. bononiensis.

ZONE I. (Zone of Bairdiocypris purbeckensis), 2450-2503 ft.

Pseudoolites and shales. Much anhydrite.

The fossils form a typical assemblage:-

Bairdiocypris purbeckensis (Forbes)
Neocytheridea bononiensis (Jones) with Serpulids and small gastropods.

This zone is a good deal thicker at Arreton that at Durlston. It seems almost certain that this is due to the removal of the main anhydrite beds by solution at Durlston, hence the "Broken Beds".

PORTLAND 2563-2650 ft.

Sandstones and sandy limestones. Ostracods were found throughout the Portland. They were all species characteristic of the Lower Purbeck and it is possible that they were all due to contamination from the overlying beds. On the other hand they were all species which appear to have had a wide tolerance for salinity changes and so could conceivably be indigenous. Such forms as Darwinula leguminella, D. oblonga and possibly Neocytheridea bononiensis also, have a long history and made their appearance long before Portlandian times.

KIMERIDGE CLAY 2650-3757 ft.

Grey shales with occasional foraminifera and echinoid spines.

Characteristic ostracods were found as follows but it is clear that the succession of forms observed in Germany and used for zonal subdivision does not obtain in Britain:-

Cyprideis wolburgi Steghaus (in samples 2713-6 ft., 2807-10 ft., 3555-60 ft., 3520-25 ft.,)

Cyprideis hiltermanni Steghaus (in samples 3540-45 ft.)

Protocythere sigmoides Triebel, (3615-20 ft.)

"Cytheridea" sp. (2807-10 ft.)

? Campocythere sp.
? Gomphocythere sp.
? Cytherella sp.

Metacypris cf. forbesii Jones (2875-80 ft.)

CORALLIAN 3757-3973 ft.

Occasional echinoid spines, some foraminifera.

OXFORD CLAY

Occasional echinoid spines, foraminifera common, some gastropods.

- - - - - - - - - - -

No fossils were seen below the Oxford Clay. No samples received below 4623 ft.

- -

Comparison with Durlston and Portsdown

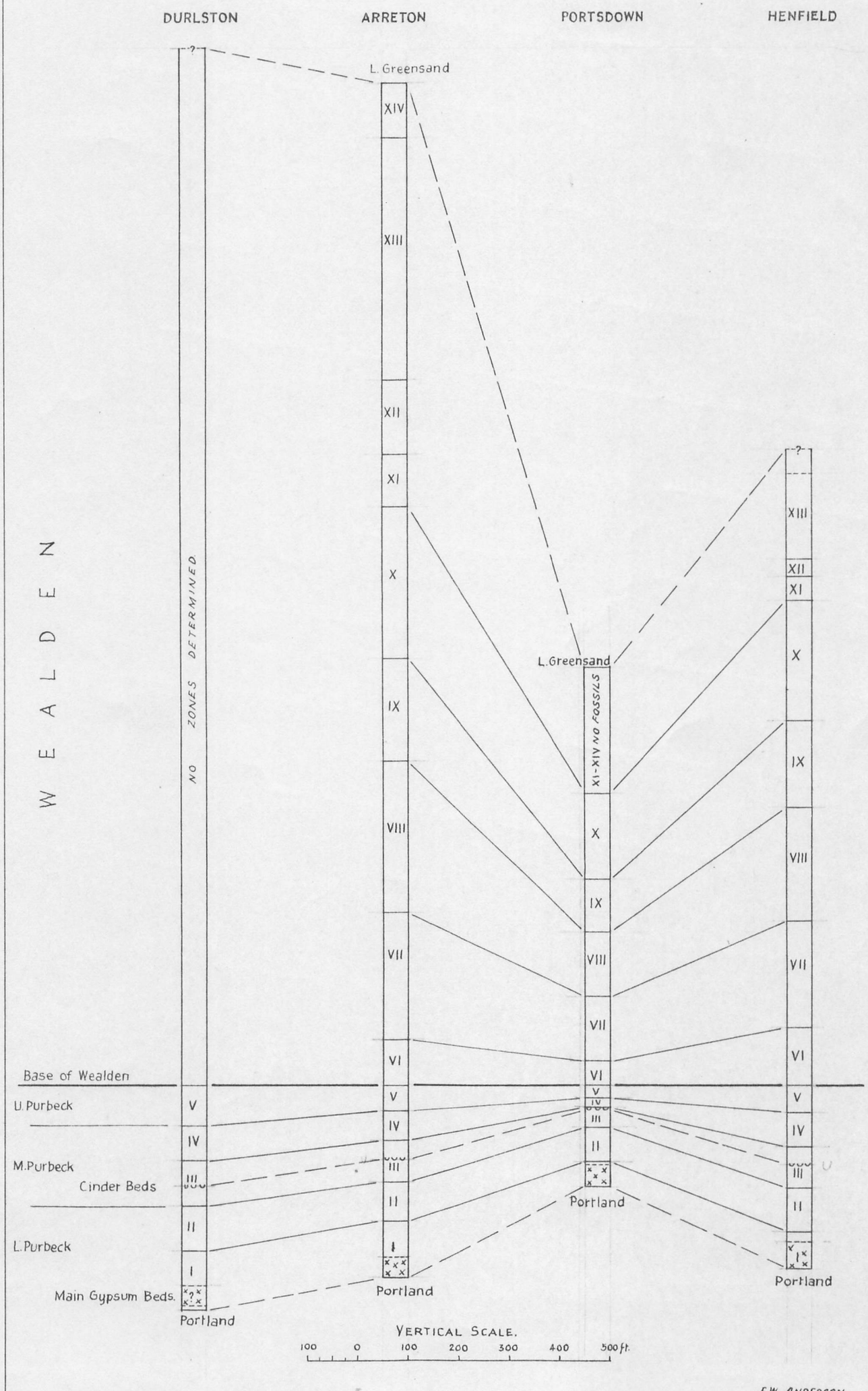
In the Arreton Well the thicknesses of the zones in the Purbeck lie between those at Durlston and those at Portsdown, though they are closer to the Durlston thicknesses than Portsdown. The thinning in the upper part of Zone III which is so marked at Portsdown is seen to a less degree at Arreton. The thinning at Portsdown was caused by a ridge, the Winchester Ridge, which was in existence in pre-Purbeck times but which moved again shortly after the Cinder Beds were deposited. The evidence from the Arreton Well suggests fairly conclusively that the maximum elevation of the ridge lay to the east of Portsdown.

F.W. ANDERSON

Diagram attached.

Distribution:-
Chief Geologist
Resident Geologist (Eakring) 6
Production Records.
Paleo. Lab. Records.

Comparative Sections showing variation in thicknesses of Zones at Durlston Bay, Arreton No 1 Well, Portsdown No 1 Well, & Henfield No 1 Well.



D'Arcy Exploration Company Limited - Geological Division

Report R.G.M. 4

Geological Completion Report on Arreton No. 1 Well, Isle of Wight

by

R.G. MacLean supplemented by P.E. Kent

PD/54/73 Appendix D (iii)

Jurassic Fossils from the D'Arcy Exploration Co's Boring at Arreton, Isle of Wight, collected by R.V. Melville and J.C.G. Smart 1953

PURBECK BEDS - Owing to the detailed study of the ostrocods from this formation by Dr. F.W. Anderson, little attention was given to macrofossils in the cores. The following list merely confirms, so far as it goes, the classification suggested by Dr. Anderson.

Upper Purbeck	Unio sp.	2249½ - 2251 ft.
Middle Purbeck	Ostrea distorta J. de C. Sowerby) - top leaf of Cinder Bed	2316
	Neomiodon sp.	2316½
	Ostrea distorta	2321
	do. do. (main Cinder Bed here)	2325
	Neomiodon spp.	2327½
	Corbula sp.	2336
	Neomiodon and Valvata sp., with Lepidotus sp.	2344
	Neomiodon sp.	2346
	Neomiodon and Valvata sp.	2347½
Lower Purbeck	Protocardia purbeck - ensis de Loriol	2470½
	Hydrobia sp.	2471

PORTLAND BEDS - Fossils were collected between 2563 and 2579 ft. i.e. in the top 16 ft. of the 87 ft. assigned to this formation. The species are characteristic of the Portland Beds, but do not indicate particular horizon within them.

Camptonectes suprajurensis (Buvignier), Isognomon sp., Plicatula lamellosa Cox	2563½ ft.
Camptonectes (Camptochlamys) lamelloses (J. Sowerby?	2570

Kimmeridge Clay - Cores were available only from the basal 25 ft. of this formation, but no fossils were found which would diagnose the palaeontological horizon with any precision.

Liostrea dubiensis (Contejean)	3741 ft.
indet. Perisphinctid. (?Subdichotomoceras sp.) no clue to horizon	3750
Thracia depressa (J. de C. Sowerby, Corbula sp., indet. Perisphinctid	3753

CORALLIAN BEDS - The cores of this formation proved to be disappointingly poor in fossils, so that no correlation with the Dorset Coast succession can be suggested on palaeontological grounds.

limestone with (?) leached corals	3826 - 3846 ft.
limestone with recrystallized corals	3846 - 3865
Chlamys (Radulopecten) fibrosa (J. Sowerby), Exogyra nana (J. Sow.)	3907¼
C. (R) fibrosa	3907¾
fossil wood	3912
Isognomon sp.	3919
C. (R) fibrosa	3954
do., Exogyra nana	3955¾
do., Mactromya acests (d'Orbigny)	3956½

OXFORD CLAY - Cores were available only from the topmost beds of this formation. Ammonite-fragments indicate the lower part of the zone of Cardioceras cordatum as would be expected in this position in the formation.

Myoconcha texta (Buvignier)	3974 ft.
Cardioceras sp. indet.	3978
do. sp. juv.	3978¼
Plasmatoceras ? sp. indet.	3984

KELLAWAYS BEDS - These beds are of exceptional geological interest because their thickness - 99 ft. - far exceeds the greatest development hitherto known in this country. They fall readily into an upper division of hard, silty to sandy argillaceous rocks (from 4423 to 4471 ft.) from which ammonites of the zone of Proplanulites koenigi are recorded, and a lower, shale and mudstone division which yielded no ammonites, although a variety of other fossils was recovered. These two divisions may be broadly correlated with the Kellaways Rock and underlying Kellaways Clay of inland districts, although in the Weymouth district (Arkell 1947, Geology of the Country around Weymouth, etc. (Mem. Geol. Surv.), p. 27 the Kellaways rock yields ammonites of the next higher zone of Sigaloceras CALLOVIENSE.

The fauna of the British Kellaways Beds has not been thoroughly studied and is very incompletely illustrated in British literature, so that species unrecorded from this country as well as someapparently new to science are encountered in almost every new collection from these beds. Items of palaeontological interest in the appended list include an apparently undescribed species of Procerithium (Rhabdocolpus) at 4497¼ ft., an undescribed species of Anisocardia sensu stricto, with well-marked radial striaton, at 4498 - 4504 ft. and an apparently undescribed species of Nucula at 4510 ft.

Proplanulites? sp. juv.	4434 ft.
Chlamys (Radulopecten) sp. juv., (? young of scarburgensis Young & Bird sp.) Praeconia sp.	4436
Liostrea (Catinula) alimena? (D'Orbigny)	4437½
Proplanulites sp. juv.	4438¼
do. indet., (Mediolus sp.)	4439¼
P. aff. koenigi (auctorum)	4439½
C. (R) scarburgensis L. (C) alimena, Pleuromya alduini (Brongniart)	4439¾-4440
L. (C) alimena	4441
do.	4442
Proplanulites aff. Koenigi (auctt.)	4443
P. sp. indet.	4444
L. (C) alimena with impression of ammonite	4444¼
L. (C) alimena C(R) scarburgensis	4445½
L. (C) alimena, Lucina sp. Meleagrinella sp.	4447¾
Meleagrinella sp. (? braamburienses Phillips sp.)	4447¾
L. (C) Alimena	4449¼
C. (R) scarburgensis	4450
L. (C) alimena, Pleuromya sp.	4450½
Myophorella sp.	4451½
L. (C) alimena	4452
do.	4452½
do. Pholadomya sp.	4453½
do. ?Rhynchonelloidella sp.	4454¾
do. R. cf. varians (Schlothein)	4455
Liostrea (Catinula) alimena	4455¼
do.	4459
do.	4460¼
do.	4466½

Pholadomya sp.	4472
Anisocardia sp.	4472¾
Palaeoneilo morrisi (Deshayes) Corbula macneilli Morris	4497
P. morrisi, C. Macneilli, Procerithium (Rhabdocolpus) sp., ? nov. Astartid ("Gouldia" cordata auctt)	4497½
C. macneilli, Astarte cf. dowrense Cossmann, Liostrea (Catinula) alimena	4497¾
C. macneilli, Anisocardia (s.s.) sp. nov.? cf. choffati de loriol (Boden 1911, Geol.Pal. Abhandl. N.F. vol. X, pl. vi, fig. 7 only)	4498
C. macneilli "Gouldia" cordata	4498¼
do., Anisocardia as above	4499½
do., Thracia depressa (j. de C. Sowerby)	4499½
do., Dicroloma (Pietteia) sp.	4500
do., Anisocardia as above	4500¼
do., do. Quenstedtia sp.	4501½
do., do. Procerithium (Rhabdocolpus sp.)	4502¼
do., do.	4503¼
Aniscardia as above	4504½
do.	4504½
Modiolus sp.	4504
do. Liostrea sp.	4509

FULLERS EARTH - Brachiopods from this formation were the subject of a report from Mr. H.M. Muir-Wood dated 17th May, 1953. The specimens there referred to are now registered in the Geological Survey collections and are not repeated below. The only new records deserving comment are an indeterminable Ornithellid at 4982 ft. and Acanthothiris doultingensis Richardson & Walker at 4984 ft. These do not call for any modification of Dr. Muir-Wood's opinion as to the horizon (Lower Fuller's Earth).

Ornithella sp. indet.	4982 ft.
Acanthothiris doultingensis Richardson & Walker, Entolium corneolum (Young & Bird) "aulacothyris" cucullata S. Buckman	4984 ft.
indet. Proceritid	4984¼
Acanthothiris sp.	4985
A. midfordensis R. & W. Rhactorhyncia sp., Entolium corneolum	4990

INFERIOR OOLITE - This formation was cored only in the lowest ten feet of the borehole (5150 - 5160 ft.). The fossils indicate a horizon in the "Top Beds" of the Inferior Oolite in Dorset, for Parvirhynchia pellucida was described from the zone of Garantiana garantiana of Burton Bradstock and Acanthorthiris occurs only in the "Top Beds" of the formation, and there abundantly

Parvirhynchia pellucida S.S. Buckman	5151½ ft.
Acanthothiris sp.	5153

Ammonite-determinations quoted above have been provided by Dr. L.F. Spathm F.R.S.

R.V. Melville

1.1.2.54