FARNHAM GEOLOGICAL SOCIETY

NEWSLETTER SEPTEMBER 1978

vol – (4th)

"THE EOCENE JAWS"

June 24th 1978, 10.30am., a chilly wind blew in from the English Channel as Society Members gathered in the car park at Bracklesham (20p a ticket, and come back in as many times as you like!).

Windcheaters were donned and Marjorie Outlaw (having changed her sleeveless summer dress - the sun was shining - for more wintry garb!) showed us what to expect when we went over the wall! A fearsome specimen of Odontaspis, 3 cm of needle sharp, striated tooth, met our awe-struck gaze; against which Gonispora websteri, Cardita (Venericor) planicosta, Nummulites laevigatus and Ostrea plicata paled into insignificance. After a brief dissertation upon the Eocene formation in the Hampshire Basin, we were ready to face the unknown shore! Would Odontaspis and Lamna show themselves? Polybags at the ready, heads lowered, the party split up and scanned the shore before the in-coming tide. Much was revealed, Nummulites, Turritela and Cardita were there in profusion (shall we set up a stall at the next Maltings Market?). But lo - there, glinting on the eastern flank of a groyne - too good to be true - could it be - yes a 40 million years old shark's tooth, the "EOCENE JAWS"!

As the water rose, it being a Spring tide, towards the wall, we retraced our steps to the car park. Pleasantries were exchanged over wine and cold sausages and then we were off to view the treasures of Mr. Fowler, who has scanned the shores at Bracklesham and Selsey since 1961. Our mini-jaws were as nothing compared to the "full-sets" so elegantly displayed by him. To our amazement crocodiles and their coprolites, turtles and their carapaces and wonder of wonders the hip joint, teeth and tusk of Palaeoloxodon were revealed to our stunned gaze. As in a dream we looked, murmured and were impressed! The miniaturists were also catered for in the shape of minute fossil pearls and microfossils only to be appreciated with the hand lens.

Mrs. Fowler kindly proffered tea and biscuits, which were immensely welcome, as we stared at the turtle's skull which has been named for Mr. Fowler. Although we were all taken in by it, the one he displays is a glass-fibre replica made by the British Museum which has retained the original. Mr. Fowler dispensed specimens of Gonispora websteri (one of which maybe seen in the reference collection) and we set off with many thanks and renewed vigour for the shore.

Alas, the tide was slow in retreat and we had a jolly time looking at the amazing collection of bric-a-brac revealed in the shops at Bracklesham. Ice-creams were enjoyed and we returned to the car park to eat tea, as the waves crashed onto the pebbles at the top of the beach and we despaired of seeing the sand again. Gradually however, the sand revealed itself and we set out on our quest. Ian Dormor, having arrived late and missed the Fowler collection, stepped onto the wet sand and was instantly arrested by a large specimen'. After a struggle he managed to lift and place it securely in his polybag!

Happily we scoured the sand, until wet feet and a lazy wind drove us off the beach, delighted by our encounter with the Eocene Jaws.

Many thanks are due to Marjorie Outlaw for organizing the "shark hunt" and to Mr. and Mrs Fowler for their generous hospitality.

Diana Smith

"Questions and answers" are on Page 3. If you have a question, please put it to Dave Taylor, our knowledgeable and efficient Secretary, for the next Newsletter.

THE ORIGIN OF CHERT IN THE LOWER GREENSAND

Impersistent bands and nodules of chert are more or less prominent in parts of the Hythe, Bargate and Folkestone Beds. The majority of the cherts are blue-black or a limonitic brown in colour, and structurally consist of a cryptocrystalline aggregate of SiO_2. A surprisingly high proportion of chert pebbles contain an organic nucleus, usually a sponge spicule.

Chert was thought to have been formed by solution and recrystallisation of siliceous sponge spicules. However, this process is now considered to account for the provenance of chert only in occasional instances. Spicule cavities are frequently preserved in fine detail in a siliceous matrix, suggesting that the matrix must have been deposited before the spicules were removed in solution; therefore the silica from the spicules could not have contributed to the chert in which the cavity is preserved. Also, no cherts have been found in the calcareous facies of the Hythe Beds, although hollow casts of spicular debris are profuse.

Calcite and pseudomorphs after calcite are totally absent from the cherts and cherty sandstones of the Hythe Beds, implying that their formation is not a result of the replacement of $CaCO_3$ by SiO_2.

Chert owes its origin to the primary accumulation of silica gel on the sea bed, the silica having been precipitated from river water inorganically as electrolytes in the sea water. The cherts possess a colloform structure of spherical crystallisation indicative of a colloidal origin. The ultimate source of the silica for the formation of chert would appear to be the weathering under humid tropical conditions of igneous rocks or quartzitic sandstones.

As the rocks associated with the cherts are often coarse-grained sandstones, it is debatable whether silica could have accumulated in sufficient concentration for precipitation to occur in the presence of a relatively high energy environment. The accepted model for precipitation of a silica gel is of a near static energy environment free from suspended detritus. However, the Lower Greensand Beds are thought to have been deposited in a marine environment with strong seasonal influences. This is possibly illustrated by the cross-bedding in the Folkestone Beds of the Western Weald which are often draped by a thin lamina of fine silt which faithfully follows the outline of the cross-sets. The silt representing a period of quiet between relatively short periods of high energy sedimentation.

The appearance of the cherty Lower Greensand rocks is due to two secondary processes; decalcification and silicification, which have taken place sometimes independently and sometimes in conjunction. According to Richardson the chert bands have been decalcified, and silicification has followed closely upon removal of the calcium carbonate;

1) the rocks first become rather porous, friable, and brown due to oxidation of glauconite,
2) with increasing loss of calcite they become very porous and flaggy,
3) when decalcification is almost complete the rocks revert to loose, incoherent sand,
4) the finely disseminated silica gel is disolved and subsequently redeposited as beds, nodules and lenticles.

Although chert occurs in all three sandy divisions of the Lower Greensand in the Wealden province, it is completely deficient in the corresponding beds of the Hampshire Basin. This stresses the role of palaeogeography in governing the distribution of silica, probably effected by the presence of the east-west trending Portsdown axis which separates the two basins.

Richardson, J.A. 1946, Chert Formation in the Bargate Beds of the Churt Neighbourhood, Surrey. Proc. Geol. Ass., Vol.58, pp 161-177.

Dave Taylor

Question:- What are "Bristol Diamonds"?

Answer:-

The Bristol diamonds are quartz nodules which occur in the Triassic Dolomitic Conglomerate in the Bristol area, specifically at Clifton. They are commonly geodes lined with well-developed crystals of quartz which, in the sixteenth century, were mistaken for diamonds. The Dolomitic Conglomerate is an alluvial fan deposit composed principally of clasts of Carboniferous Limestone and Old Red Sandstone, interbedded with which are braided stream deposits and thinly bedded sandstones and marls of playa origin. The Dolomitic Conglomerate passes laterally into the Keuper Marl, which contains evaporite minerals.

The quartz nodules are generally sub-spherical, mammillated, ranging in size from 3-15 cm. The geodes possess a two-layer structure: an outer part of milky quartz, and an innermost region of clear, glassy, finely-terminated quartz crystals. The milky layer is distinguished by the presence of numerous microscopic inclusions of elongate, rectangular anhydrite in a common orientation. The glassy quartz consists of relatively large equant crystals, entirely devoid of inclusions. The contact between the milky and glassy quartz has crystal terminations determined by the inclusions.

The presence of anhydrite inclusions in the outer layer of the quartz geodes indicates that they have formed by the replacement of anhydrite nodules. The inclusions are remnants of larger lath-shaped crystals of anhydrite. Recent nodular anhydrite deposits from the Persian Gulf sabkhas commonly possess orientated lath-shaped crystals. As previously mentioned the Bristol Diamonds are mainly geodes, suggesting that as replacement of calcium sulphate by silica proceeded, there was an increase in sulphate solution over silica replacement resulting in the development of a central void. The continued precipitation of silica resulted in the growth of the glassy inclusion-free crystals with fine terminations, developed into the central void. The occurence of inclusion-defined terminations between the milky and glassy quartz coincides with the changeover from quartz replacement to quartz precipitation.

Solution and replacement of the Triassic anhydrite nodules probably reflect the passage through the sediment of fresh groundwaters, rich in silica and poor in sulphate. The anhydrite probably formed marginal to a playa in an arid or semi-arid climate. The suggestion of the former presence of anhydrite in the Triassic of the Bristol area, implying sabkha-type diagenesis, is consistent with the known palaeogeography of the time.

Question:- When is a marl a limestone?

Answer:-

Marl was originally defined as "a semifriable mixture of clay materials and lime carbonate, with 35-65% carbonate and a complementary content of clay" (Pettijohn, F.J., 1957, Sedimentary Rocks, New York). However, the great latitude in tolerance of the percentage of carbonate makes the use of the term 'marl', as just defined, as a strict lithologic species extremely difficult to apply.

Recent work on the Great Oolite of Oxfordshire has shown that the relative proportions of carbonate to clay control whether or not recrystallization produces a cohesive rock. Calcareous sediments tend to recrystallize readily, even under the slightest diagenetic temperatures or pressures. Where there is little clay and a high proportion of carbonate, on recrystallization the carbonate crystals come into intimate content to form a coherent mass. However, where there is a high percentage of clay, this forms films about the carbonate crystals, isolating them, so that even when they recrystallize they are separated; and the clay being adsorbent, continues to give the whole sediment plasticity when wet. Therefore it can be seen that the carbonate/clay ratio is a more significant expression of the texture of marls and limestones than the carbonate content alone. Based upon this work a new definition has been proposed: "Marl is a mixed rock containing clay minerals and aragonite or calcite, usually together with accessory components, such as silt, in lesser quantity. It is friable when dry, and plastic when wet".

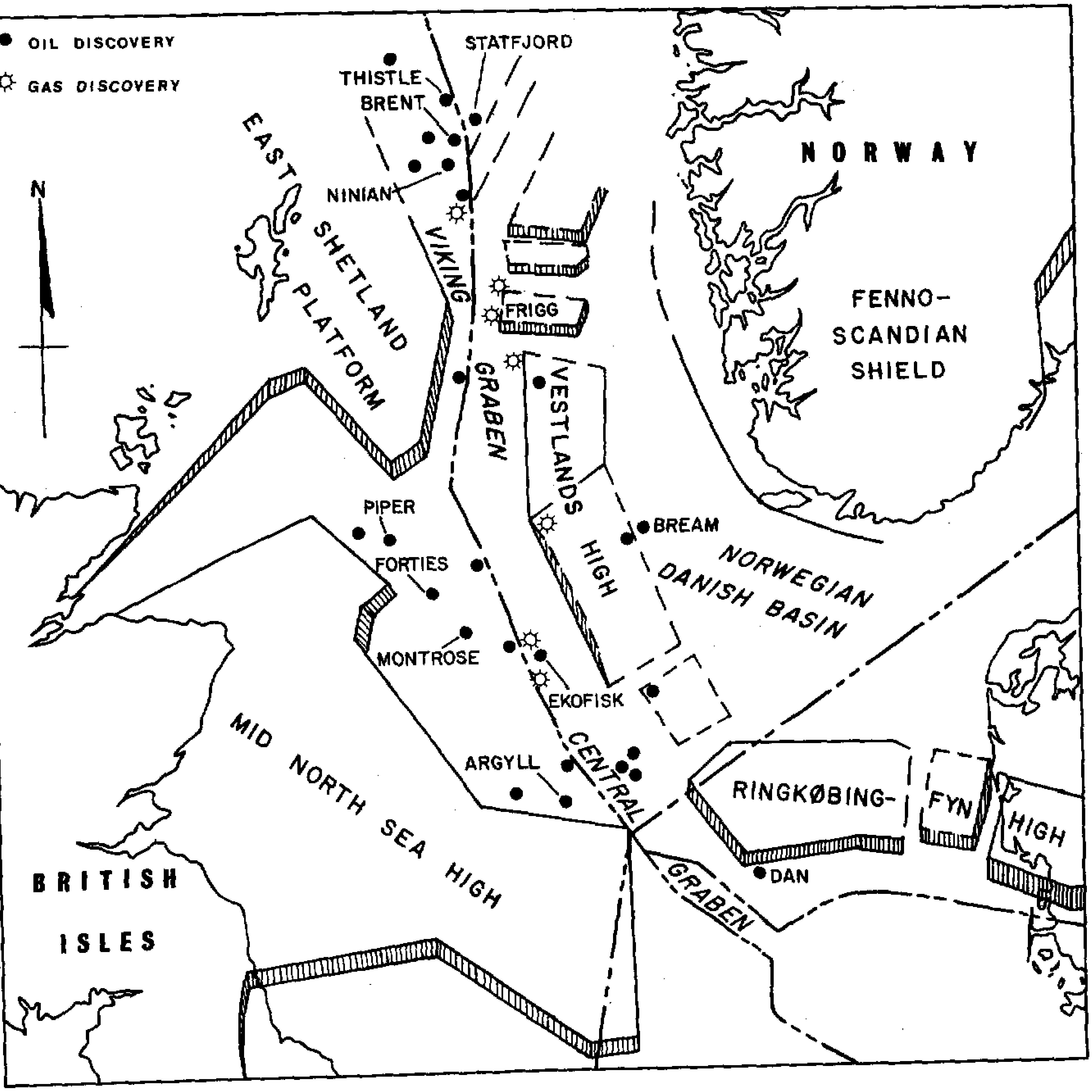
Reference: Sugden, W. & McKerrow, W.S., 1962. The Composition of Marls and Limestones in the Great Oolite Series of Oxfordshire. Geol. Mag., Vol. 99, pp 363-368

THE NORTHERN NORTH SEA:- A HYDROCARBON PLAY

Beneath the North Sea exists an extensive volume of petroliferous sediments. Oil was first discovered in the U.K. sector of the North Sea by Amoco in 1969 (Montrose), the breakthrough coming with B.P.'s discovery of the Forties Field in 1970. A spate of oil discoveries followed B.P.'s success, the greatest being Shell/Esso's Brent Field in 1971 which, at maximum production, will produce 500,000 barrels of oil per day (1 barrel = 40 gallons) - about one quarter of Britain's current consumption. A notable number of discoveries during 1975 and 1976 have extended the proven reserves of the U.K. sector by 27% to 10.3×10^9 barrels.

The northern North Sea basin has a strongly differentiated trough and plateau structural fabric (Fig. 1), revealed to the greatest effect in the Mesozoic strata. As a graben system evolves, tension produces normal faulting parallel to the graben axis. With continuing tension the fault blocks rotate toward the centre, so that individual blocks dip away from the axis. Such structures, which characterise a tensional stress regime, are common throughout the northern basin and have so far proved the most productive. The Mesozoic and Cenozoic deformations which produced these structural styles were influenced by an old structural grain within the underlying Palaeozoic craton.

Fig.1



Main Structural features of the Northern North Sea with field locations

Nearly all significant discoveries in the northern North Sea can be assigned to three structural styles:

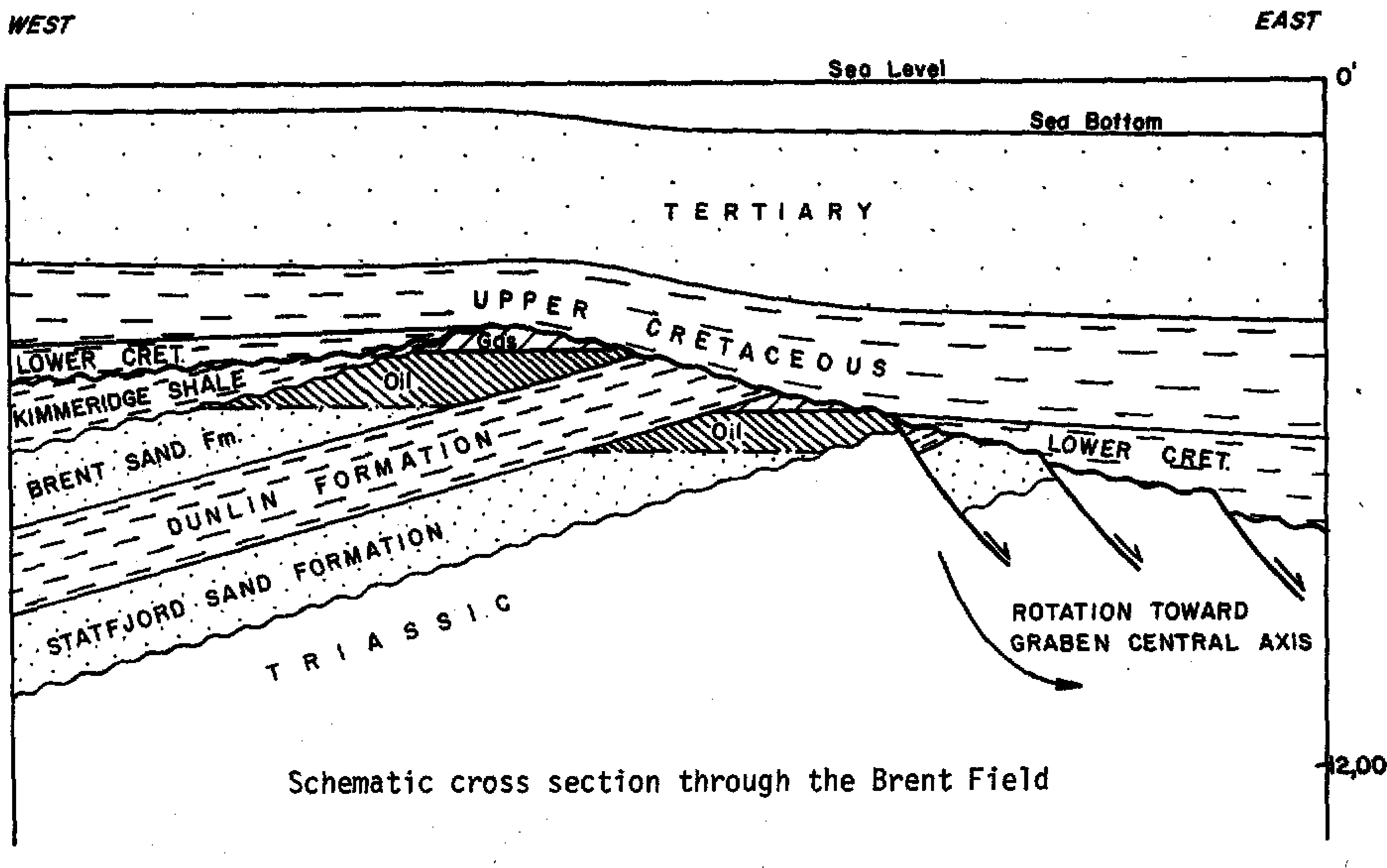
1) Basic tensional structures characterised by rotated fault blocks, horsts and grabens with subunconformity reservoirs developed in sands and porous limestones, typified by the Brent Field.
2) Drape, compaction or late movement structures, as in the Frigg Field, where the depositional topography of the Tertiary sediments have been heightened by late movement over a deep rotated fault block.
3) Salt supported diapiric structures as illustrated by the Ekofisk Field.

Thick Mesozoic sediments are restricted to the grabens. On the intervening horsts the sequence is either much reduced or absent, due to the combined effects of erosion and non-deposition. An important difference between the northern and southern basins of the North Sea is that throughout the Tertiary the northern area underwent extensive subsidence resulting in a deep trough in which up to 11,000 ft. of Tertiary sediments are preserved. The Tertiary sands have blanketed and totally obscured the structural outline of the underlying Mesozoic.

The Lower Tertiary contains important horizons in which significant hydrocarbon discoveries have been made - Ekofisk (Danian), Forties (Palaeocene) and Frigg (L. Eocene) - all of which can be assigned to the second structural style. The other significant oil-bearing reservoirs in the northern basinal area are Middle Jurassic deltaic sandstones. The traps are afforded by large rotated fault blocks within the Viking Graben. This structural pattern probably has its origin in the Permian. The movement on the graben margins occured during the Jurassic, and continued until the end of the Lower Cretaceous.

It seems most likely that the source beds for the hydrocarbon accumulations in the Jurassic sand reservoirs are the organic-rich shales with which they are interbedded. The temperatures and pressures required to initiate the generation and migration of hydrocarbons would not have been sufficient until such time as the source rocks had become buried beneath several thousands of feet of sedimentary cover, towards the end of the Cretaceous. Owing to its extremely rich hydrocarbon reserves the North Sea is today one of the most productive sedimentary basins of the World's continental shelf.

Fig. 2



Schematic cross section through the Brent Field

Example:- BRENT FIELD (Fig. 2)

The Brent Field was the first major Jurassic discovery in the Viking Graben - discovered by Shell/Esso in 1971. The Brent Field is located on an asymmetric, north-south trending, westerly gently dipping, partially eroded fault block. The graben underwent subsidence from the Triassic onwards and contains a thick sequence of Triassic and Jurassic sediments. At the end of the Middle Jurassic a period of extensional stress produced rotated fault blocks, followed by uplift and rapid erosion. The erosion was succeeded by rapid subsidence and the deposition of deep water Kimmeridge shales. A second period of uplift was followed by further erosion. The resultant unconformity was buried beneath Lower Cretaceous reddish marls and Upper Cretaceous siltstones and claystones. There is a gentle arching of the Cretaceous and Tertiary strata over the crest of the Jurassic feature.

There are two main reservoirs, both sandstones, one of Middle Jurassic (Brent Sand), the other of early Jurassic to Rhaetian age (Statfjord Sand), separated by Liassic shales and siltstones. The overlying sealing shales range from late Jurassic to Cretaceous in age. A gross reservoir thickness of 1550 ft. is found with combined recoverable reserves estimated to be in the order of 2.0×10^9 barrels of oil, with 3.5×10^{12} cubic feet of associated gas.

Dave Taylor

Geological crossword: * denotes a chemical element, e.g. AU for Gold.

ACROSS

1. Igneous rock, normally less than 50% silica.
4. Radial partition in cup of rugose coral.
7. Flint and chert are this type of rock.
9. Low hill of drifted sand (letters jumbled)
10. Form of agate containing small dendritic growths of iron oxide.
11. A richly fossiliferous ---- delights a field trip!
12. Some trilobites had large compound ones.
13. Blocky lava.
14. Clastic sediment of fine particles.
16. Crystals made up of two crystals of same mineral differently orientated.
17. Between Paleocene and Oligocene.
23. ---cambrian time is eight times as long as all subsequent time.
24. The Mesozoic era was their 'Age'.
25* Not in free state in nature, but abundant compounds include calcite and gypsum.
26. Paleozoic corals, having bilateral symmetry, solitary or colonial.
27. Trade name for diamonds too flawed or poor in colour for jewellery.
30. --gradation lowers the neighbourhood!
31. Vertical inclination of vein or fault.

DOWN

1. Sphalerite is often called zinc ------.
2. Describes igneous rocks rich in silica.
3. About 225-200 million years ago.
4. Massive talc (soapstone).
5. Graphite used to be called ----bago.
6. Common ------ (<u>Mytilius edulis</u> L.) forms dense colonies in shallow saline water.
7. Crystalline variety of gypsum.
8. A ---- lake contains large amounts of salts of sodium and magnesium sulphates.
13. Mountains or islands set in a great curve.
15* Bluish-white, brittle metal of crystalline structure melting at 520 deg C.
16. Collective term for all fragmentary volcanic material blown from a vent through the air.
18. The -----cene epoch saw a rise of mammals.
19. A virtual synonym of 16 down.
20. Point on Earth's surface directly above the focus of an earthquake is the ---centre.
21. The common form of crystalline quartz is a hexagonal -----.
22. Man---s appeared in Africa at the close of the Pliocene.
27* The emerald element.
28* White metal, in native platinum and in copper ores of Sudbury, Ontario.
29* Not however a constituent of 7 down!