POCKET DEPOSITS

S. Derbys

KSTTC

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JOHN REYNOLDS

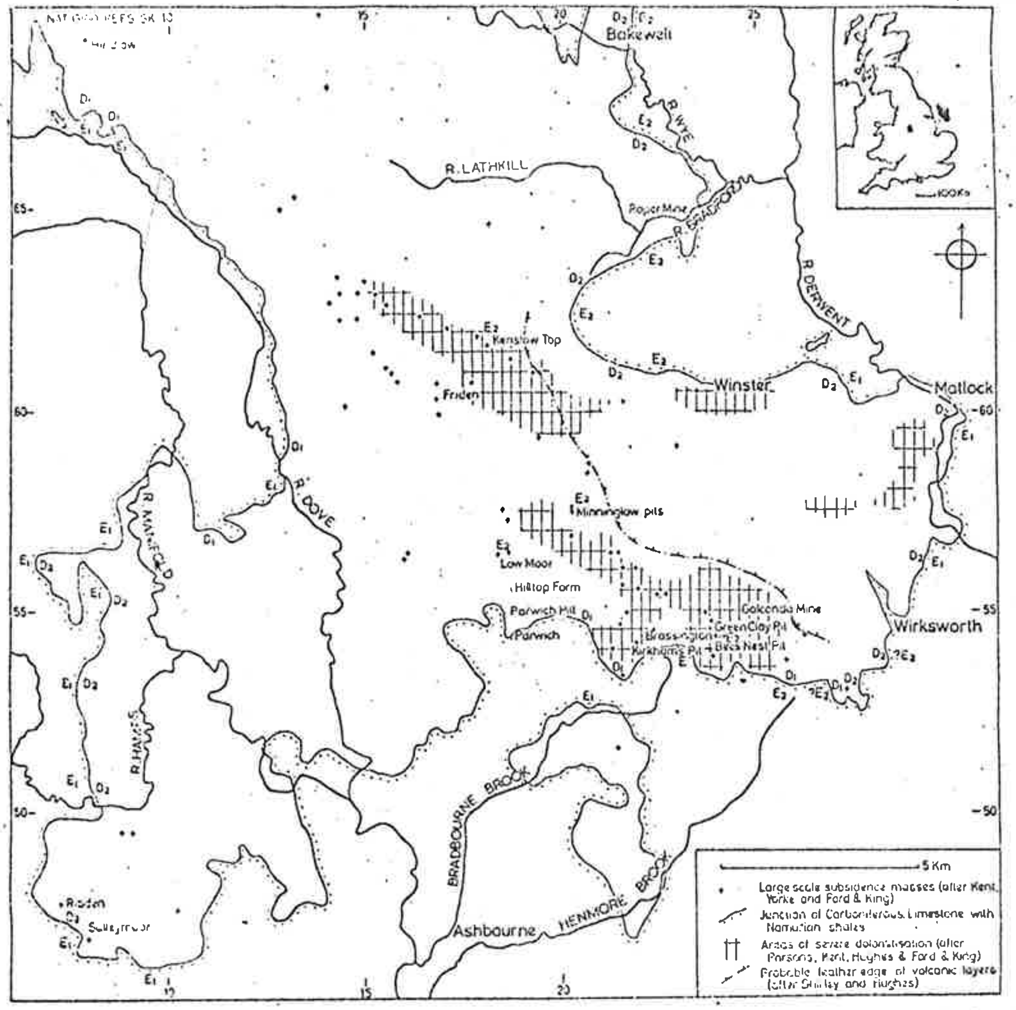
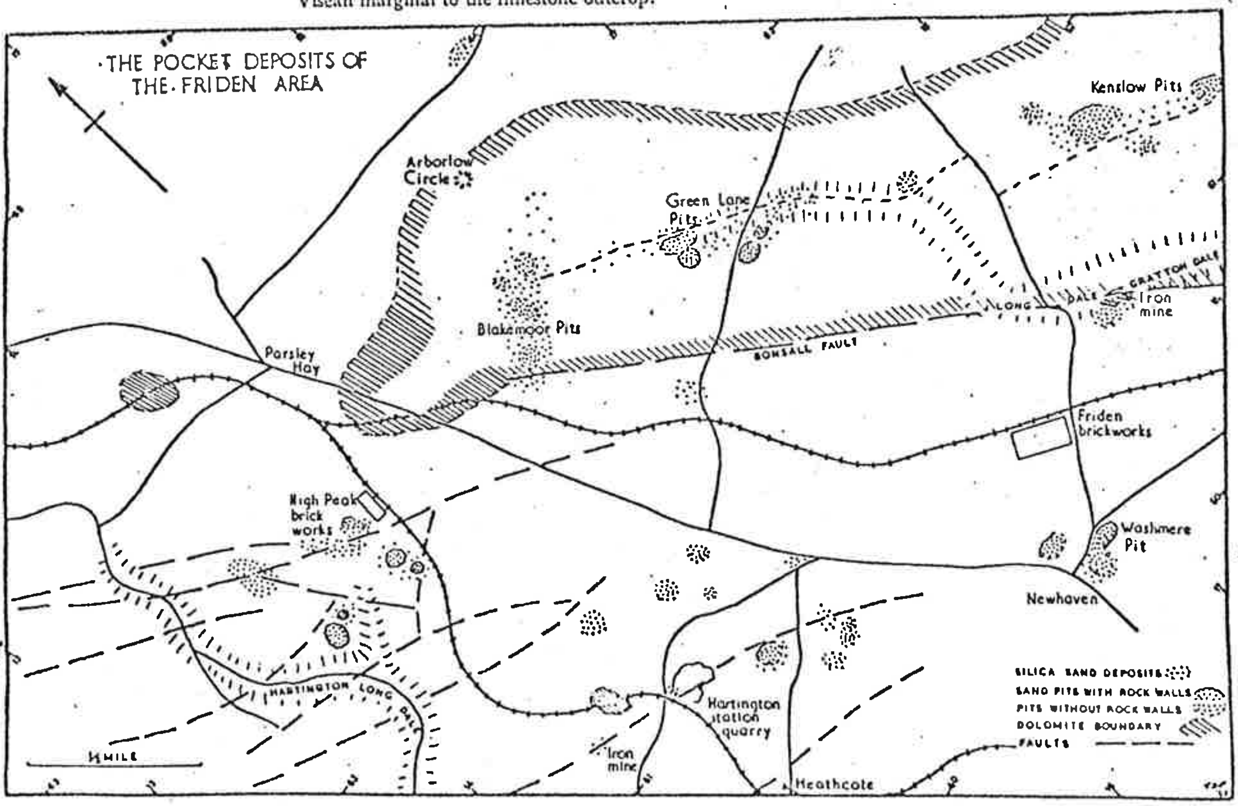
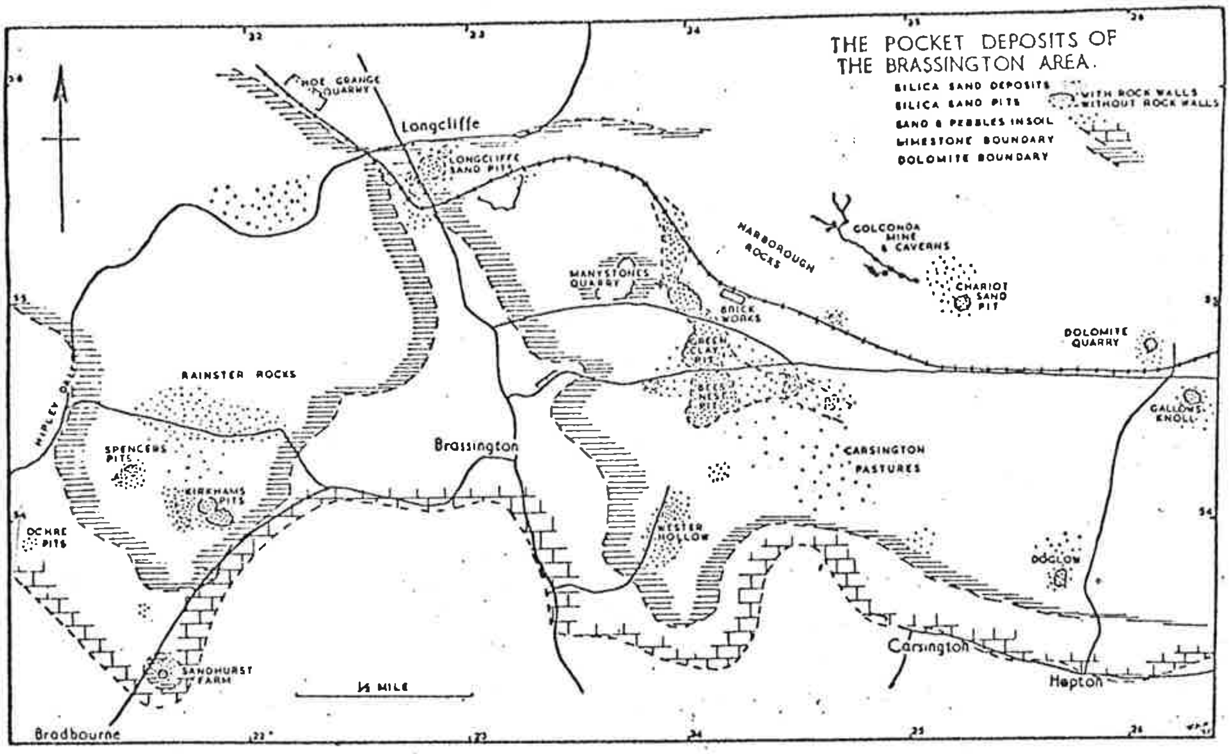


FIG 1. Map to show (1) the location of the research area (2) the localities mentioned in the text and (3) E1 & E2, the age of the basal Namurian sediments at various localities (the latter partly after Ford (1968) and Morris (1967 and 1969) and I.G.S. sources. (4) D_1 & D_2, the age of the youngest preserved Viséan marginal to the limestone outcrop.



Text-Fig. 3



Text-Fig. 2

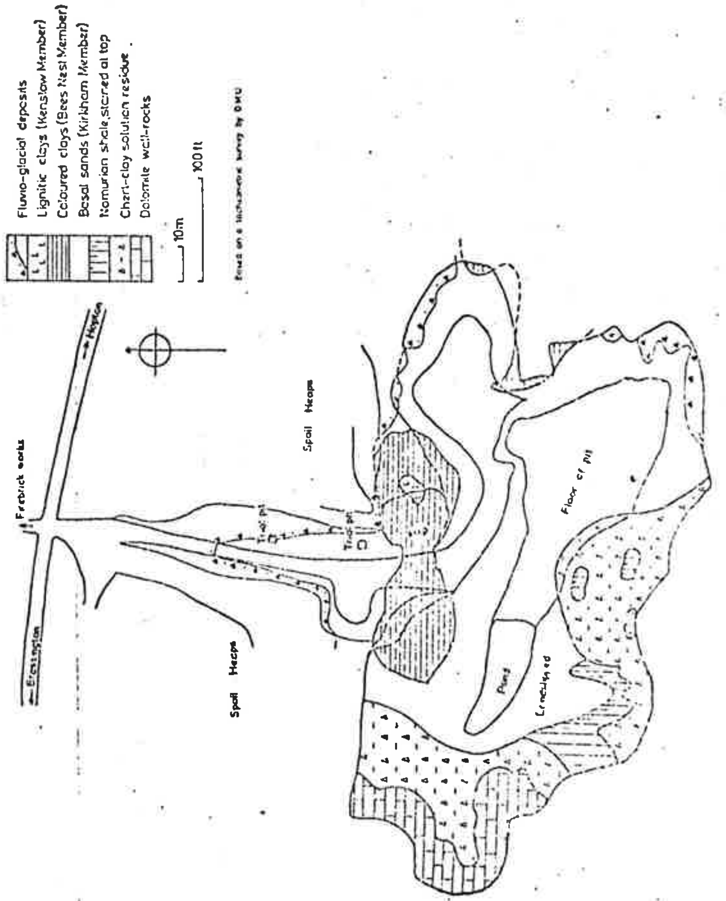


FIG. 2A Map to show the location and geology of the Bees Nest Pit.

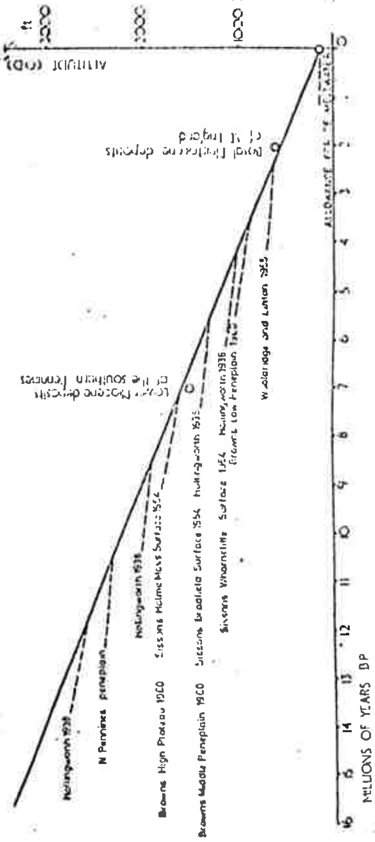


FIG. 7 Graph to show the possible rate of uplift of the Upland areas of the British Isles during the Neogene period. The age of the basal Pleistocene and basal Pliocene sediments after Funnel (1964).

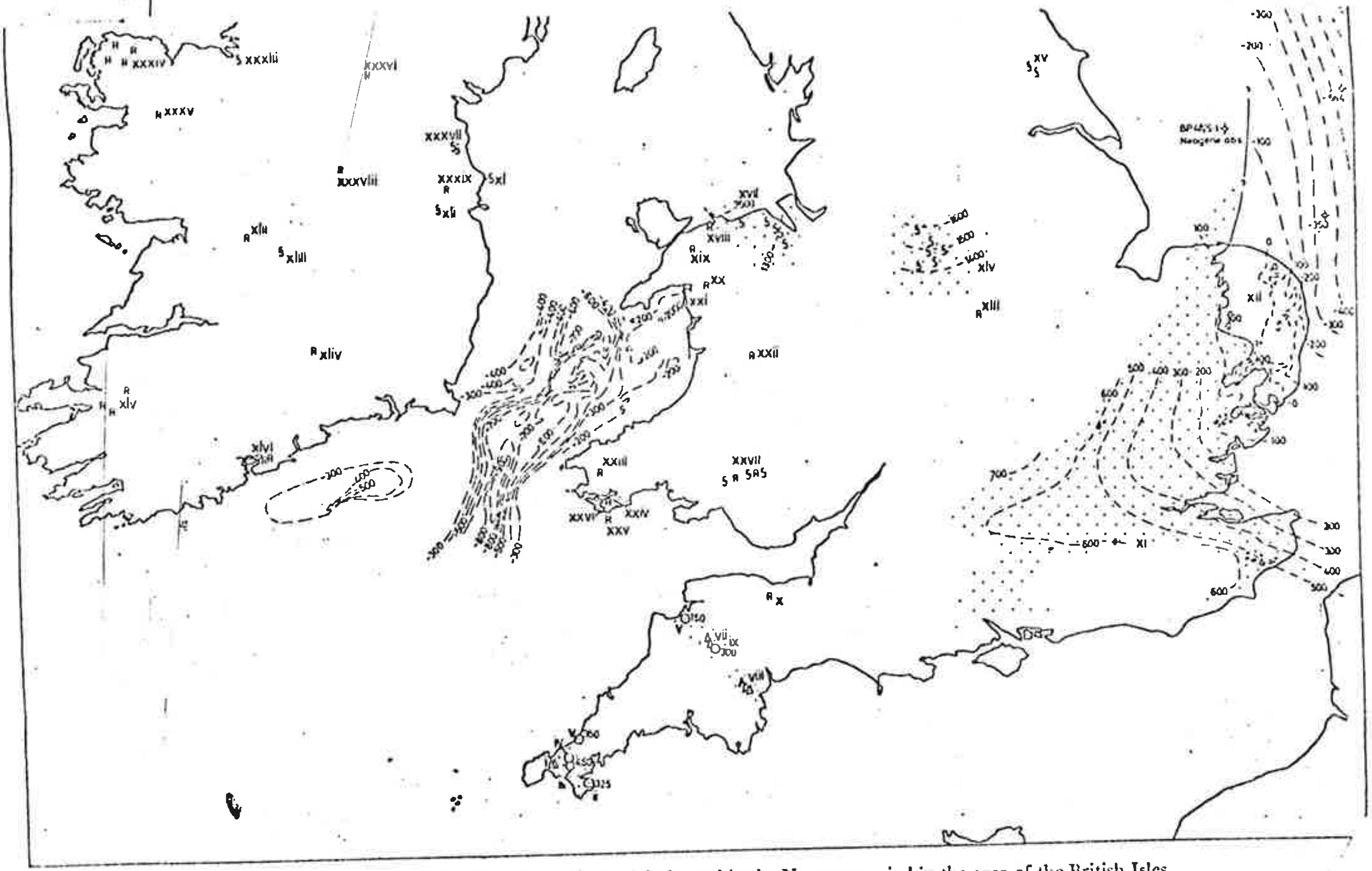
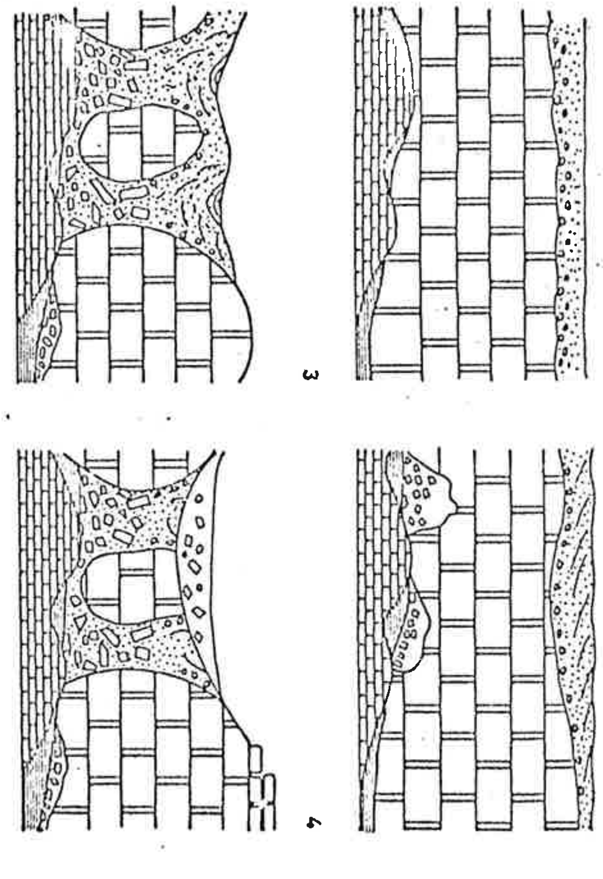


Fig. 6 Map to show the location of some materials formed in the Neogene period in the area of the British Isles and on the adjacent Continental Shelf.

Text-Fig. 4



1. Triassic: Bunter Pebble Beds rest on dolomitized Carboniferous Limestone with unaltered limestone beneath. Solution cavities along the contact of dolomitized and unaltered limestone are filled with layered galena-baryte deposits.

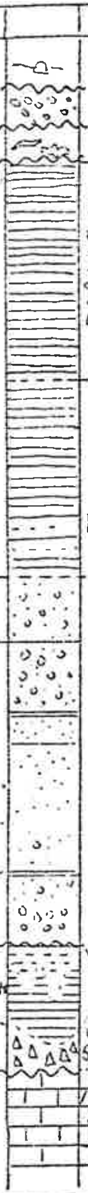
2. Tertiary: The Bunter escarpment has receded from the Carboniferous Limestone leaving fluvial fans of Tertiary clays, sands and gravel resting on the dolomitized limestone. Increased ground-water movement has led to solution of the residual calcite in the dolomitized limestone and thus to cavern collapse in 'favourable' areas.

3. Late Tertiary: Continued collapse of the cavern roofs has allowed the Tertiary sand and gravel cover to sag into the "Pockets". Ponds in the tops of the sags receive plant debris from surrounding heath-lands in addition to aquatic vegetation.

4. Pleistocene: Glacial scour removes most of the remaining sand and gravel cover, leaving only the "Pocket Deposits", in the solution collapse hollows. Till lies across both Pockets and adjacent wall rocks. In late Pleistocene times dolomite hills are weathered into tors.

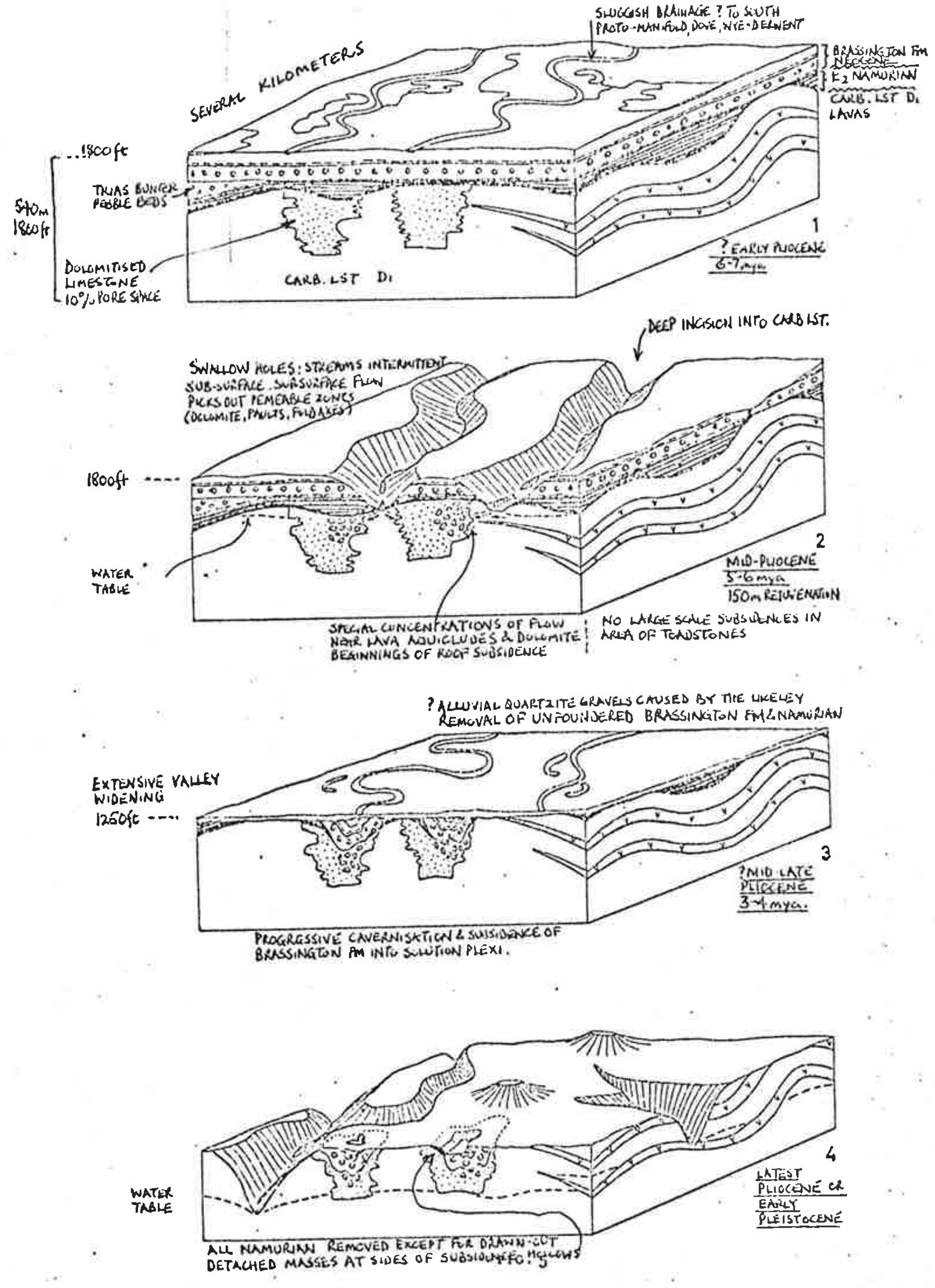
basal Pliocene sediments after Funnel (1964).

THE DERBYSHIRE SILICA PITS



AGE	DIVISIONS	LITHOLOGY	FOSSILS	INTERPRETATION
PLEISTOCENE	up to 6m (20')	Brown mud - sand - angular & rounded gravel ? Till . Loose dolerite avalues on land surface.	derived fossils (? including Namurian shale blocks.)	Solifluction ? fill due to ice of unknown age not Weichselian
	GRAVEL	Quartzite & quartzose sst pebbles	no fossils known	Alluvial spread - the result of wastage of Brassington Formation
UPPER PLIOCENE - LWR PLEIST	CAVE DEPOSITS	Brown clays with bones	Mastodon, Hyena, Deer, *Equus bressanus*	Equivalent to faunas of E. Anglian Crags Red Crag to Cromer Forest Series
NEOGENE: UPPER MIOCENE - LOWER PLIOCENE (6-7 my)	BRASSINGTON FORMATION (BNP): KENSLOW MEMBER up to 6m (20ft) ? unconformity	Grey and green clays at BNP, Kenslow, Kirkham's, and ? also Hindlow. Organic clays and lignite. Up to 10% gibbsite (an Al clay mineral) Lignite fragments rest on Namurian Shale at Hindlow All clays with similar consolidation characters to those of the beds below. Walsh et al 1972 claim continuity. Claims of unconformity by some. Good exposure reveals passage. Gibbsite persists below junction.	63 pollen and spore taxa, 40 pollen taxa, 36 with known affinity to present day plants. Pollen and spores attributed to woody and herbaceous angiosperms, conifers, pteridophytes inc. club mosses, mosses eg sphagnum Macrofossils - 3 sp conifer wood; 5 sp " cones; 3 sp angiosperm leaves; 5 sp seed & fruit; 3 sp fungi, 1 sp moss } modern genera but not modern species Comparison with Mochras borehole, Holland & Germany (the coastal swamps on edge of proto North Sea, Poland (discontinuous coastal swamps), Bohemia (freshwater swamps in Cheb, Sokolov, and N. Bohemia), S. Europe (swamps at border of European plate at the edge of shrinking Tethys). Flora different, however, than those of Ballymacadam (Tipperary), London and Hampshire Basins, Bovey and Petrockstow Basins, Mull, Antrim, L. Neagh all of which have been dated botanically and by K-Ar to be Lower Tertiary. Flora has not great affinity with the species in the subtropics today	Kent (1957) - Kenslow and Bees Nest Member = Keuper Marl. Shotton found L. Pleistocene pollen in 1960. Chaloner (1960) and Boulter (1971) show that this is a U Miocene - L Pliocene flora of the dates shown. Montford (1972) thinks that the flora is mostly a facies flora and of no age significance. Upper Cretaceous - L Tert floras extended from C. Europe - N Europe - Arctic. Cooling of the arctic at the beginning of the Tertiary as plates moved northwards caused the "geoflora" to move south. Climatic variations and differing rates of evolution brought about provincialisation. Little firm idea is available of the direction and speed of spread of plants, but climatic comparisons with regions of today reveals that 30% of the flora is now restricted to the tropics and sub-tropics. Extinction rather than evolutionary change best accounts for the changes of today. Palaeomagnetism suggests European plate drift north so that a warm temperate oceanic climate with small seasonal fluctuations in temperature (suggested by the plants) is reasonable. The mineral gibbsite suggests more extreme, more tropical types of weathering and does not conform with these predictions very well. Sedimentary evidence suggests a fluvial cycle of deposition on a flat plain near sea level. As time elapses paludal swamp conditions develop.
	BEES NEST MEMBER 7m at BNP (>43m at BEES NEST PIT)	Coloured clays now mottled red and green	No fossils known in Bees Nest Member.	Scott (1927) believed these to be Carboniferous sands: Yorke (1954-61) said they were Permian: Kent (1957) that they were Triassic and equal to normal succession of BPB-LKS. Ford and King (1968-9) believed them to be Tertiary, being reworked Trias. Walsh et al (1972) regard them as U Miocene - Pliocene.
(beds 1-7, 12)	KIRKHAM MEMBER 35m at BNP (70m thick at KENSLOW)	Sand and gravel beds, originally lilac red now often bleached. Originally cemented, now soft. Odd clay beds as above. Heavy minerals like those of the Trias Odd ventifacts Cross bedding from the NE acc. to Hughes 1952. Particle size distribution is not log normal as is that of the BPB at Hulland	No fossils known.	Most regard these as fluvial piedmont, riverplain (& windblown) deposits of a single cycle of deposition. Any further cycles of deposition may have been eroded. There is little evidence of the direction of transport. Walsh et al (1972) suggest a plain sloping down southwards from 1600ft (having been uplifted at a rate of 1 metre every 15,250 yrs since its inception as a flat plain near sea level. Precipitation of iron compounds cements early pebble beds Pre subsidence landscape believed by Walsh et al (1972) to be an Upper Miocene - L Pliocene land surface at 450m OD (1500ft).
NAMURIAN ARNSBERGIAN	cf EDALE SHALES	Lilac shales Black shales	Namurian palynomorphs of E_2, E_2-R_1, E_1-G_1 age but ranges little known Goniatites eg *Eumorphoceras*	Kent (1957): late stage collapse of shale into sinkholes as scarps retreat in Trias. Ford, King (1968) - blocks of shale brought by ice in late Pleistocene. Walsh et al 1972: shales are slipped blocks from Namurian cover which slipped down only in Tertiary when Brassington Fm foundered.
?	CHERTS up to 5m BNP	Angular chert - uncemented, unmineralised. Not always present	No fossils known.	Evans: A solution residue from D_2 limestone or from bedded chert; preserved only where solution hollows existed before Namurian transgression. Walsh et al: cherts formed from solution of Lst beneath Namurian Shale
DINANTIAN - VISEAN D_1	TRIAS, BPB, CARB. LST	(Trias sometimes uncomformable on Carb Lst or Millstone Grit. Limestone (crinoidal biospararenite). Dolomitised and dedolomitized and silicified in places. Solution cavities filled partly or wholly with mineralisation	*Dibunophyllum* sp., *Lithostrotion martini*, *Chaetetes septosus*, *Productids* mostly of an age about *C. septosa*.	Shelf sea: folding faulting before dolomitisation, dedolomitisation silicification, solution and mineralisation.

DBT 72



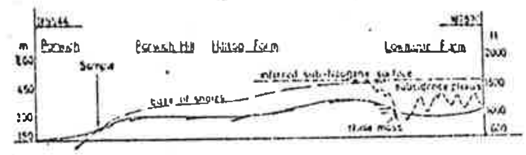


Fig. 3. Section to show the geology between Parwich and Low Moor Pit. Natural scale. Length of section 2.5 km.

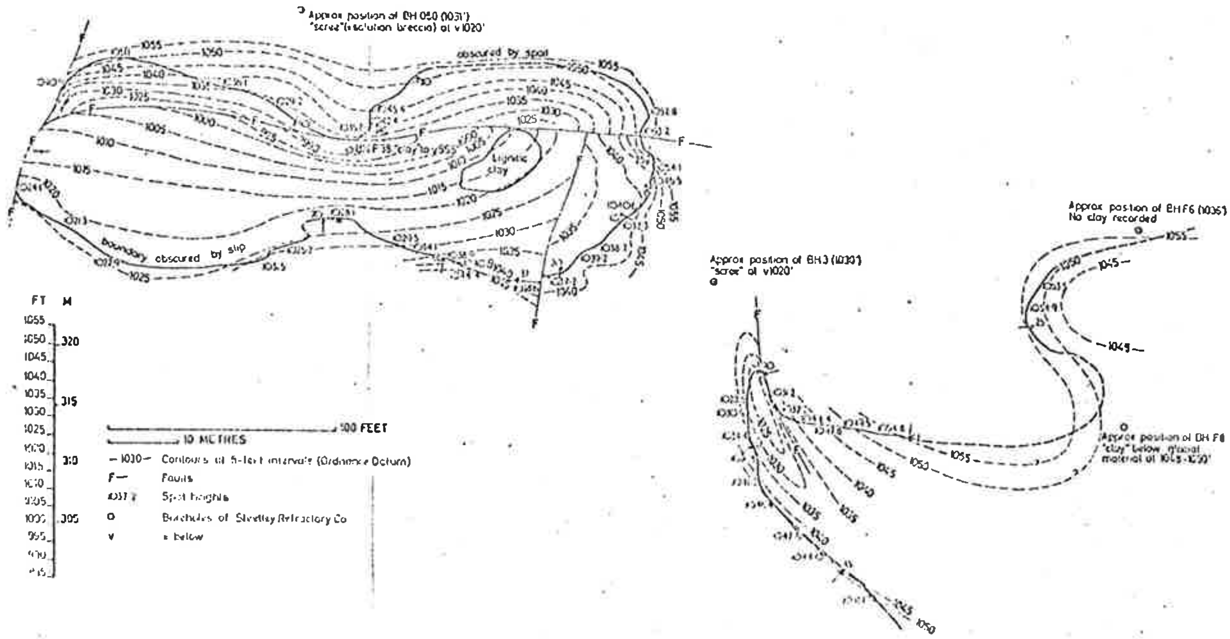


FIG. 2B Map to show the structure of the deeper parts of the subsidence complex at the Bees Nest Pit. (Geological sections across the Bees Nest 1 green clay pits solution complex have been drawn during site investigations for silica sand extraction. These are confidential to the Steetley Refractory Firebrick Company).

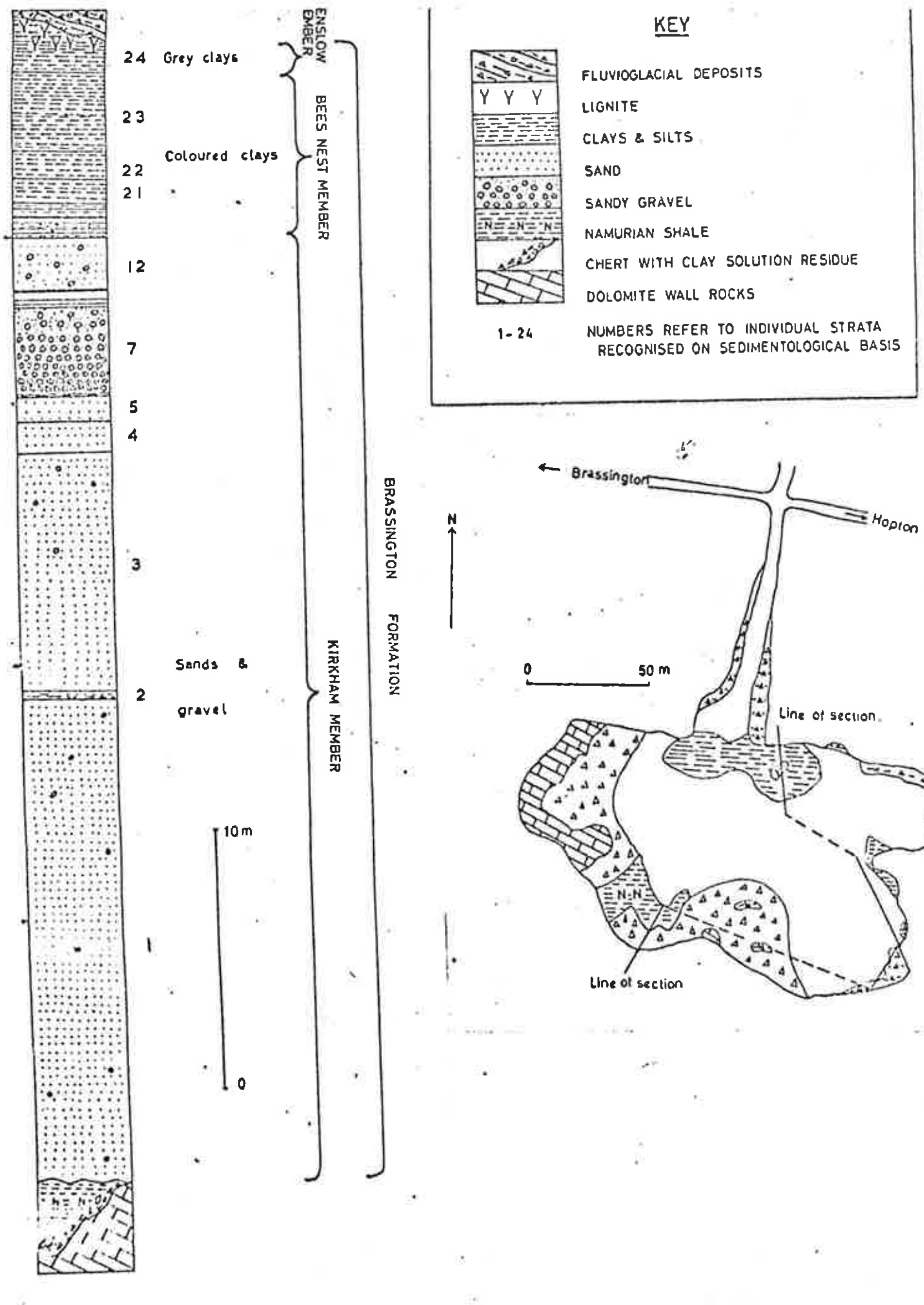


FIG. 5 *Block diagrams summarising the postulated sequence of events leading to the present day form of the Pocket Deposits outliers.*

1. The sequence of models is entirely synthetic in its composition, but all have in mind the general area between Matlock and Winster and the southern margins of the Limestone massif. The southern aspect is dominant in each case and the initial height of the model is ca. 1800 ft (540 m). The length of each side is several km.

Model 1 purports to illustrate the general geological relationships in *?early Pliocene times* (6–7 *m.y.B.P.*) following completion of Brassington Formation sedimentation and with initiation of a strong uplift of the region. A sluggish drainage is initiated on the upper surface of the Pocket Deposits sheet. Anastomosing streams are shown to follow a general southerly direction, for which there is no particular field evidence. Warwick (1964) however, has suggested a superimposition of the existing Derbyshire and Staffordshire mainstreams, and the early ancestors of the Manifold, Dove and Wye-Derwent may date from this event. The near-horizontal sheet of Neogene sediment is shown to rest mainly on Namurian shales and grits (black) and also, symbolically, on the Bunter Sandstone (dots and circles) in the south west. A window in the Carboniferous Limestone (possibly related to an exhumation of a Permo-Triassic erosion surface) is shown in the north west. The disposition of the two volcanic layers (v–v) symbolises the essential features of the pre-Neogene fold structure as mapped along the Derwent Valley. Two irregular zones of dolomitised limestone are shown in the southern aspect; these are possibly related to other Permo-Triassic windows, cut into the roof of the nearby Carboniferous Limestone.

2. *?mid-Pliocene* (5–6 *m.y.B.P.*) The general height of the model is maintained. The effect of the rejuvenation of perhaps 150m or so has been the deep incision of the drainage below the Brassington Formation surface. The dominance of downcutting over valley widening lead to incision into the upper part of the Carboniferous Limestone. Swallow holes developed as they have in recent times in the northern part of the Limestone massif, as near Castleton. Surface streams were thus intermittent and much solutioning took place immediately below the basal shales of the Namurian. As Ford (1968 p 329) comments, the locations of the exit springs from such a system are not yet known. In general, subsurface flow at this stage sought out the more permeable zones in the Limestone–dolomitised areas, fold axes, faults, etc., and special concentrations of groundwater flow doubtless took place marginal to the volcanic layers (Toadstones) since these are aquicludes and would have supported perched water tables. Thus, where a zone of dolomitisation lay adjacent to the feather-edge of a toadstone, cavernisation would have been exceptionally well promoted. Arrows denote the direction of this subsurface flow; the water table is marked by dashed lines. At times of critical instability, progressive cavernisation would cease, and subsidence of the roof take place. No large scale subsidences would have taken place in the areas of the toadstones as downwards migration of cavernisation would have been prevented by the presence of the non-soluble aquicludes.

3. *?mid-late Pliocene* (3–4 *m.y.B.P.*) Concommitant with progressive cavernisation and subsidence of the Brassington Formation sheet into the solution plexi, a relatively stable base level relative to the existing 1250 ft contour resulted in extensive valley widening. Removal of the unfoundered relics of the Brassington Formation sheet accomplished, together with most of the Namurian roof-rocks. Only where these materials had subsided into solution cavities were they preserved. The landscape assumed a senescent appearance and may have been veneered at this stage by alluvial quartzite gravels derived from wastage of the Brassington Formation sheet (or nearby Trias). Solution-lowered remnants of these may survive in the Matlock district represented by the gravel soils mapped by the I.G.S. (sheet SK 25NE 1961). Such a Davisian view of the development of the erosion surfaces of the southern Pennines has recently been challenged by Pitty (1968) as being rather meaningless when applied to a limestone terrain which has a regionally low water table.

4. Renewed uplift and incision of the dales are known to date from either later Pliocene or early Pleistocene times.

All of the Namurian has now been removed from the area except for the drawn-out detached masses present in the sides of the subsidence masses. Synclinal cores of Bees Nest clays (dashed lines) are all that now remains of the upper part of the original layer. The water table is again low, while the pockets support perched water tables.

The scenery is dominated now by relics of the so-called 1000 ft surface; glacial events have been ignored for the sake of simplicity.