The main Fossil Cave and other smaller fossilliferous caves have been deroofed by erosion, exposing the fossil-bearing breccia fill on the hill surface. These breccias have been mined for their deposits of pure secondary limestone. The mining operations have also modified the underground passages in many places, not only by the removal of secondary limestone, but also by the blasting of access routes through the dolomite bedrock, and the blanketing of floors with rubble.

The broad dimensions of the entire cave system are as follows: 350m from east to west and 250m from north to south. The Tourist Cave covers the largest area, 250m from east to west and 130m from north to south. Its largest chambers include the closely connected Elephant Chamber and Milner Hall which together form a void 150m long by 50m wide and about 25m high (Fig. 4.1). The Exit Chamber, Terror Chamber and Ravjee Cavern are the other large cavities in the Tourist Cave. Otherwise the Tourist Cave consists of passages of various dimensions connecting the larger chambers.

Lincoln's Cave is 130m from east to west and 90m from north to south. It comprises a main chamber (30m x 18m and 3m high) with four passages leading away from it; two horizontal low passages leading westwards, and two narrow slot-like passages descending northwards with the dip of the dolomite, to water level.

The Fault Cave is aligned northwest-southeast, being 150m long in this direction, and 120m wide. It consists of several passages trending generally northwest-southeast, which lie at various levels, and which meet at the lowest part of the cave, near the one small water body of this cave.

There are seven water bodies in the whole cave system, consisting of static water with a free surface (W1-W7, Fig. 4.3), in the deepest parts of the cave system. The largest is the Lake in the western end of the Tourist Cave (60m long and 18m wide). Water bodies No. 2 and No. 7 are very small with a surface area of less than 1m^2. The remainder are water-bodies with a surface area of several square metres. The deepest water-body as far as is known is W5, at 6m deep. The Lake is only 4m deep at its deepest point.

Five mud-filled depressions exist within the cave where water periodically collects before seeping away. One such depression, or sump, lies at a high level in the system, in the south-west branch passage of Lincoln's Cave (S1, Fig. 4.3). The other natural sumps are all to be found in the low lying Fault Cave (S2 - S5, Fig. 4.3).

There are many entrances to the cave system both vertical and horizontal. Entrances 1 - 6 (leading into the Tourist Cave) have all been enlarged by the lime miners and for tourist access paths. Entrances 7 - 15 are mainly natural entrances leading into Lincoln's Cave. Fault Cave has only one entrance (No. 16); entrances 17, 18 and 19 provide access to small, dead-end cavities in the hillside.

4.2 Analysis of the Cave Plan

It can be seen that the Tourist Cave (except Ravjee Passage and its offshoots) and Lincoln's Cave (main chamber) comprise the larger cavities when compared with those passages north of an east-west morphological dividing line (in red, Fig. 4.1). In addition, the larger cavities are aligned generally east-west, whereas the smaller passages to the north have a strong north-south component.

The Fault Cave belongs mainly to the latter category although the passages DE and DF may belong to the former (see Discussion below, Chapter 8).

The Tourist Cave undoubtedly stretched further to both the east and west (from Exit Chamber and Elephant Chamber respectively), as did the Fault Cave passages DE and DF before these extremities were inundated with large influxes of hillslope material. It may be said, therefore, that the east-west component of the larger cavities, south of the dividing line, was

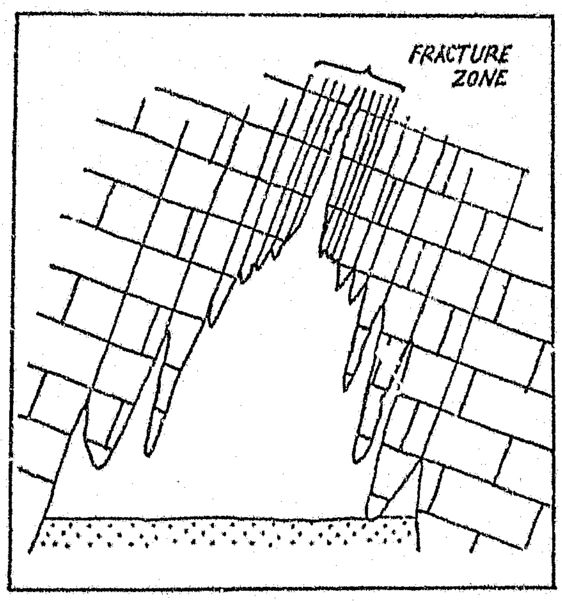

Fig. 4.4 Cavern developed along a zone of fracture

originally even greater than it appears on the cave plan.

The surface geology overlay offers some explanation on the existence of the two morphological divisions mentioned: the longest fracture zones (No. 1 - 5, Fig. 4.1) are concentrated in the portion of the hill underlain by the larger cavities, i.e. the area south of the morphological dividing line. The other, shorter fractures are underlain by the smaller passages north of the dividing line. Fracture zones 2, 3, 4 and 5, or their direct continuation underground, coincide exactly with several of the largest underground cavities. Fracture zone No. 1 determines the area of Elephant Chamber in which the dolomite partitions occur; No. 4 coincides with the Exit Chamber, Terror Chamber and northern part of Milner Hall; No. 4 also coincides with the Exit and Terror Chambers, and the whole length of Milner Hall. On the surface, Nos. 4 and 5 coincide with the Fossil Cave and large Exit Area cavity (centred around entrance No. 4, Fig. 4.3).

In the same way, fractures visible only underground, have determined the position of several of the cave voids (fractures 6, 7 and 8). In several areas in the Elephant Chamber - Milner Hall complex, narrow, slot-like chambers are found closely spaced with dolomite blades and walls acting as partitions between them. These closely-spaced chambers are aligned alon racture zones and indicate that the fracture zones consist of several parallel planes of weakness, rather than a single plane of weakness (Fig. 4.4).

North of the morphological dividing line, however, the coincidence of surface fracture line and cavity is almost non-existent, suggesting that the fractures do not penetrate the dolomite very deeply. Underground it is apparent that single fractures, rather than entire fracture zones, control the development of the passages. The morphology consists of single passages rather than a series of coalesced passages.

The map of surface geology does not supply any information on the Fault Cave; however it is apparent from observation underground that passages ABC and BG are joint-controlled (Fig. 4.3). Any surface expression which controlling fractures may have, is buried beneath the hillslope debris which is more than 1m thick on the lower slopes of the Sterkfontein hill, directly above Fault Cave.

4.3 Analysis of Modified, Superimposed Cave Sections

Cave sections were analysed to ascertain whether the sloping passages in the northern section of the cave system occupy single beds or transgress the dip of the beds. Of the five main passages only two (in Lincoln's Cave) are aligned in the direction of dip (northwards); the slope of these is therefore immediately comparable with the rockdip. The other three passages (POQ, Tourist Cave; AB and DF, Fault Cave - Fig. 4.1) are not aligned in the direction of dip however, and their slope is thus not tooreadily contrasted with the rock dip.

For the sake of comparison, sections of these three passages were drawn in the plane of rock dip thereby reducing the actual passage slopes to slopes in the plane of bedrock dip. These modified passage sections were then superimposed with the two Lincoln's Cave sections (Fig. 4.2) to ascertain the vertical and stratigraphical relationship of the passages to one another. Various correlations are apparent:

4.3.1 The major cavities, such as Milner Hall and Elephant Chamber, and parts of Lincoln's Cave (e.g. point W, Fig. 4.1) occupy fracture zones (Nos. 2, 4 and 5).

4.3.2 The smaller northern passages such as POQ (Tourist Cave), UV (Lincoln's Cave) and AB, DF (Fault Cave) occupy specific strata within the dolomite and do not generally transgress the regional dip. XY (Lincoln's Cave) is intermediate, having substantial vertical development but having developed from a single bedding plane and a single large joint.

4.3.3 Water levels can be seen to drop in !titude towards the north, i.e. towards the Blaauwbank River. (see also Fig. 7.4) The cave water levels lie between 0 and 18m below the river bed however. The resurgence question is discussed in 7.2.3 below.

4.3.4 The diabase sill which underlies the Cave system may have controlled the stratigraphic levels at which the cave has developed (although it has not developed in contact with the dyke). This is evident from the fact that a borehole drilled through the dyke struck no water even at a depth of 97m below datum: i.e. 37m below the lowest water body level within the caves. It is possible, of course, that the borehole simply failed to pierce water filled cavities possibly existing beneath the diabase sill.

4.3.5 The passages almost overlap in places, suggesting that a group of adjacent strata control these passages. Another possible explanation is that a single stratigraphic horizon may control two or more of the passages; e.g. the two Lincoln's Cave passages lie within a single stratigraphic unit. This is a possibility even though the superimposed sections do not show it because mapping errors and small changes in strike direction would result in passage sections occupying apparently different stratigraphic levels.

4.4 Summary

The Sterkfontein Cave System consists of 3 large caves lying at varying levels, and none interconnected by passable passages. Lincoln's Cave overlies the Tourist Cave and the Fault Cave is situated north-east of both. The Tourist and Fault Caves contain breccias as does the deroofed Fossil Cave. The system contains only one relatively large water body - none of the water bodies are deep, and all lie in the lowest parts of the system. Water collection points, or sumps, are found at different levels in the system mainly in Fault Cave. Many cave entrances, vertical and horizontal, pierce the hillside. Some have been artificially enlarged.

Consideration of the cave plan indicates two morphological divisions of cavity type and relationship. Larger cavities in a complex relation with one another and with a general east-west alignment comprise the southern division, whereas smaller passages of a somewhat simpler 3-dimensional pattern, and with a stronger north-south trend, comprise the northern division. A series of major fracture zones traverse the dolomite of the southern chambers, whereas the dolomite hosting the northern passages is almost devoid of major fracture zones.

Superimposed cave sections also indicate the coincidence of the main galleries with various fracture zones. They indicate strong coincidence of bedding plane angle and passage slope. Water body levels descend towards the local stream bed, although they all lie below the level of this stream bed.

The underlying diabase sill may have influenced the level at which the cave has developed.

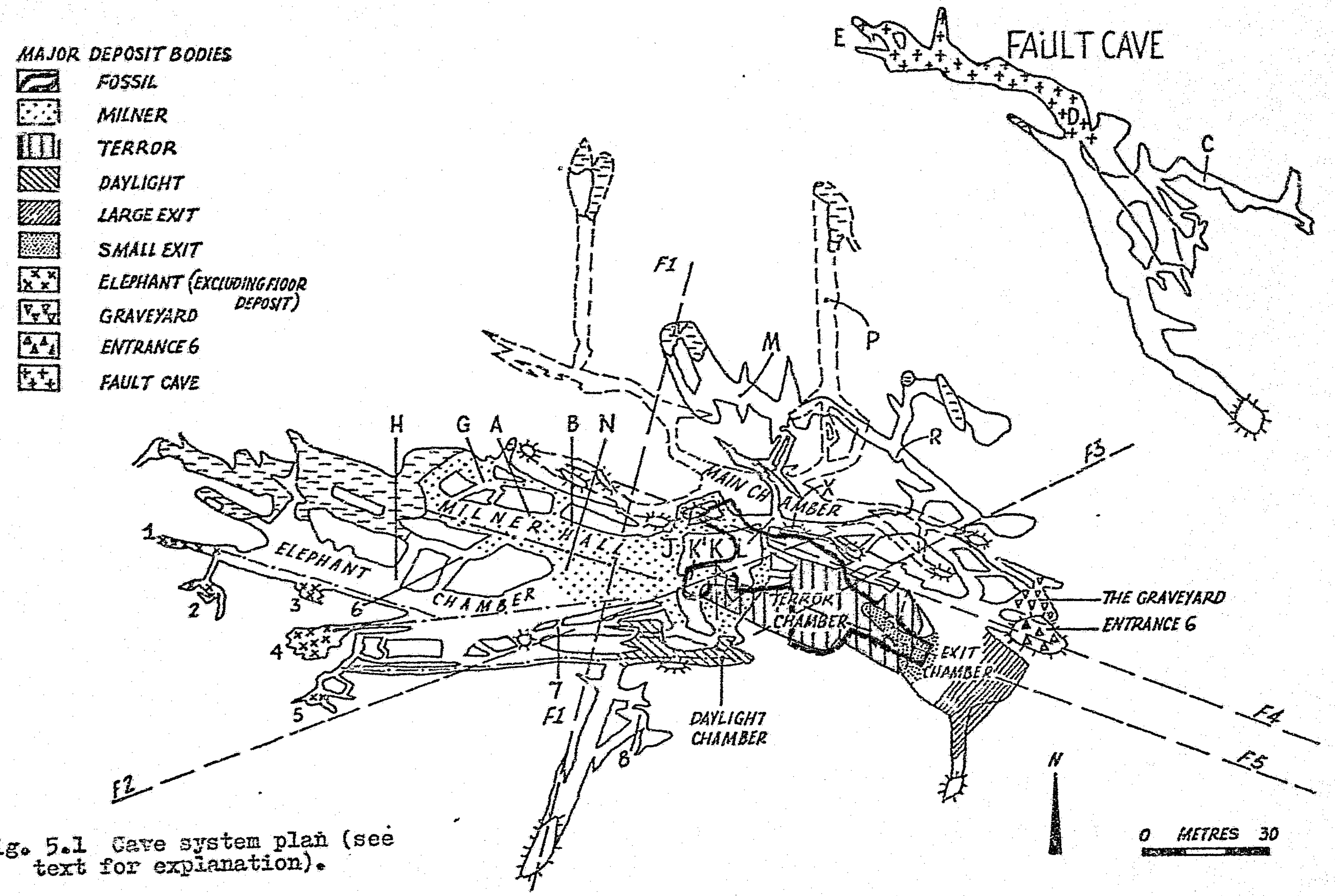

Fig. 5.1 Cave system plan (see text for explanation).

CHAPTER 5 - EROSIONAL FEATURES OF THE CAVE SYSTEM

5.0 Erosional features are classified here according to their origin, which may be by phreatic solution, or vadose erosion. Features of doubtful, and multiple phase origin are classed separately.

Phreatic features are those which form by solution of calcareous rocks under static ground water. Vadose erosion, however, is initiated by moving streams of water which flow underground and which have a free air surface. It is sometimes difficult to differentiate between true vadose and phreatic features caused by sub-water table currents. The passage of percolating water through the interstices of both consolidated and unconsolidated materials can affect the development of both surface and underground features. Percolating water cannot however, be considered as a discrete water body, such as the phreatic and vadose water bodies.

5.1 Phreatic Features[1]

5.1.1 Networks

A room south of Elephant Chamber consists of a series of high (9m), narrow (1m) interconnecting passages formed by the solutional widening of joints in the bedrock (point 2, Fig. 5.1). The passages connecting Elephant Chamber to Milner Hall (point 6, Fig. 5.1) may also be termed a network of somewhat larger dimensions (10m high, 2m wide). The upper parts of this network are encrusted with speleothems, but the lower walls are bare dolomite with protruding chert ledges.

---

[1]Phreatic features are identified in this study according to Bretz's classification, using his terminology (Bretz, 1942).

5.1.2 Partitions[2]

These are narrow, wall-like slabs of bedrock in situ which extend from the ceiling to the floor of a chamber. The best examples at Sterkfontein are found east of Entrance 1 (point 7, Fig. 5.1). Partitions may be considered as an advanced form of network developed along close-set fractures. Like networks they owe their origin to phreatic solution along the fracture planes. The partitions near Entrance 1 occur in four parallel rows, 3m apart and 10m high on average. In width they generally become thicker with height. Many become so thin at the lower ends that they taper off before reaching the floor, and thus hang suspended from the roof. Windows occur in some of these partitions due to solutional attack from both sides.

5.1.3 Bedding-Plane Anastomoses

A 2m high room, south of Elephant Chamber, appears to be confined to a single bedding plane - elongated pillars and partitions of dolomite give this room the appearance of an anastomosis. No other bedding-plane anastomoses have been encountered.

5.1.4 Joint-Determined Cavities

Examples of such cavities can be seen in the lower parts of the cave system. At higher levels they are often masked by travertine deposits. However, where travertine deposits are not present, joint-determined cavaties are visible in the higher chambers, such as the Exit Chamber.

One particular joint-determined cavity (point R, Fig. 5.1) appears to have developed as a result of the mixing of karst waters (Bogli, 1971). Although the cavity is partly filled with travertine, the controlling

---

[2] When dolomite walls lie at angles of more than 45° to the horizontal Bretz terms them 'partitions' and when lying at less than 45° to the horizontal 'rock spans'. No rock spans have been encountered at Sterkfontein.

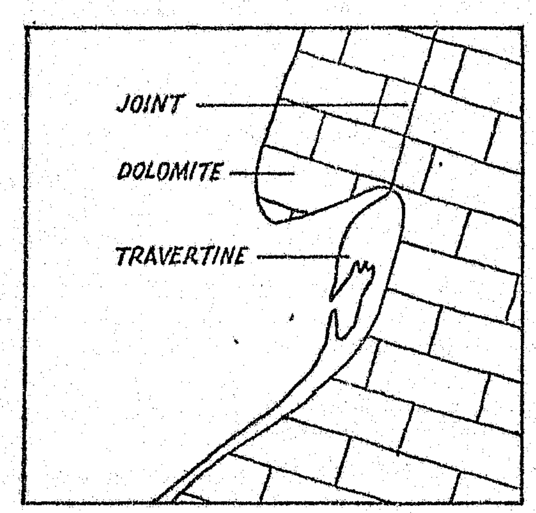

Fig. 5.2 Cavity formed possible by mixing karst water (after Bogli, 1971)

joint is visible. Karst water presumably flowed through this joint during and after the formation of the cavity (Fig. 5.2). Bretz (1942) did not envisage joint-aligned cavities forming due to the mixing of karst waters, but simply as the result of preferential solution along a joint.

5.1.5 Wall Pockets

These features are smaller than joint-determined cavities (up to 0,3m long) and do not appear to be controlled by joints; rather they appear to occupy slightly less resistent strata. They are elongated horizontally but are not asymmetric in section, and are thus not obviously features formed by current flow. Wall pockets occur in great numbers along the lower walls of the Elephant Chamber (point 3, Fig. 5.1) and also in other parts of the cave system.

5.1.6 Boxwork

This is a term to describe relict quartz veins which stand out from the dolomite bedrock giving the impression of cube-shaped boxes. They are found in the lower parts of the caves, near the water bodies, and are poorly developed, and very fragile. Protruding stylolite seams, although not as fragile as the quartz veins appear in the Fault Cave, and like the quartz veins provide evidence of phreatic weathering. Chert ledges can be seen protruding from the dolomite in most parts of the cave system and these too, being less soluble than dolomite, indicate phreatic weathering.

5.1.7 Rock Pendants

In the vicinity of Entrance 10 (Main Chamber of Lincoln's Cave) many, short (5cm) lump-like protusions hang from the ceiling. These appear to be the features which Bretz describes as 'pendants' - i.e. features developed by upward solution of a dolomite roof due to water percolating between an insoluble fill floor and the roof at a time when the cavern was entirely filled with insoluble debris. Features such as spongeworks, ceiling and floor pockets, tubes and half-tubes have not been encountered.

5.2 Vadose Features

The only modern vadose stream in the cave system is that which flows periodically along one of the lowest passages of the Fault Cave (point C, Fig. 5.1). It flows for a short distance only, before disappearing into sump No. S3 (Fig. 4.3). However, there are two erosional features associated with this steam which are worth noting:

5.2.1 Stream Trench

A small trench (1m long, 0,5m deep) is cut into a mud deposit in a small room in the passage mentioned above. A similar trench can be seen in the Tourist Cave (point 8, Fig. 5.1). However, the mud in which this trench has been incised appears to have entered the cave very recently after a dolomite wall had been blasted away by the lime miners.

5.2.2 Meander Scar

Below the trench a small meander scar (0,2m high, 0,7m long) has been cut into the passage wall, where the stream swings around a bend in the passage.

5.3 Other Features

Erosional features of a multiphase type or of doubtful origin are mentioned here - wall-grooves, smoothed surfaces and solution pockets.

5.3.1 Solution Pockets

There are solution cavities which develop downwards through dolomite or breccia by percolating vadose waters. They may be related to the cavities exploited by tree roots, in that water percolating through such cavities will be highly corrosive (due to soil carbon dioxide content).

Solution pockets mentioned by earlier workers, can be seen developed in the breccias of the Fossil Cave where these breccias have been exposed on the hillside. The solution pockets are filled with unconsolidated

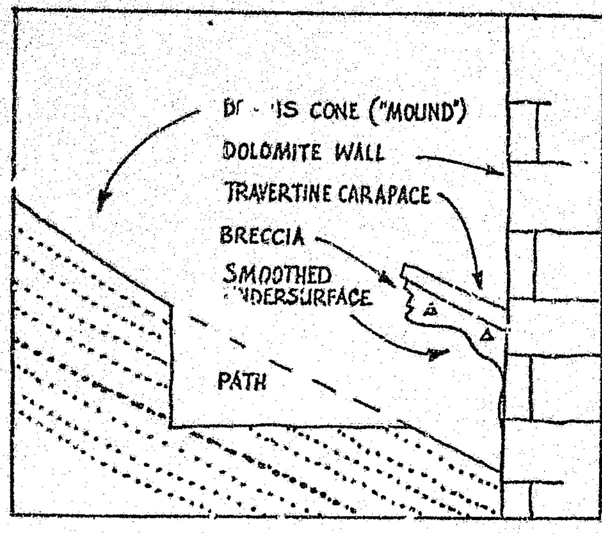

Fig. 5.3 Smoothly-eroded breccia undersurface (Mound breccia, Milner deposit)

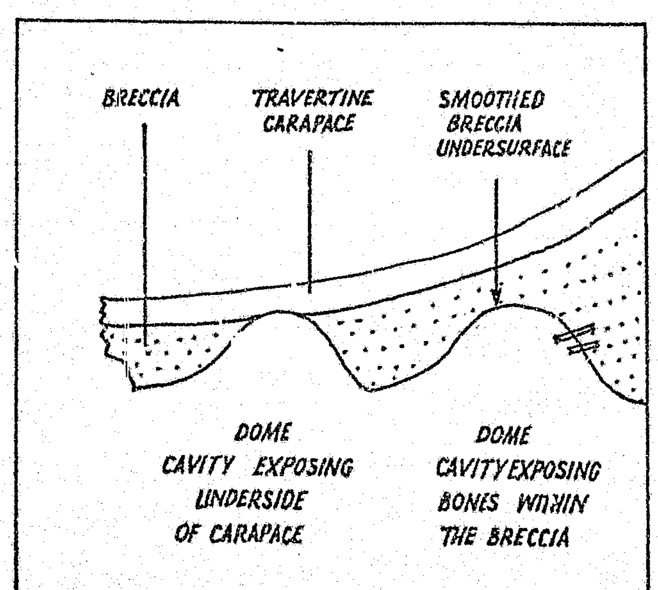

Fig. 5.4 Dome cavities in Mound breccia (Milner deposit)

mate al, both *in situ* decalcified breccia material and hill wash collected by the solution pockets. Some solution pockets are not soil-filled, but lead directly down to the underground caverns and are therefore better termed avens. A cross section of such a cavity can be seen in the north wall of the Type Site (point X, Fig. 5.1) where it descended into Lincoln's Cave, as Entrance 12, until it was largely destroyed by mining operations.

5.3.2 Smoothed Surfaces

A comparatively small body of pinkish brecc.a is attached to the wall high in the eastern end of Milner Hall (point J, Fig. 5.1). On its underside this breccia ('Mound breccia') has been eroded and presents a smooth surface. Only a small portion of the breccia remains against the wall overhanging the pathway (Fig. 5.3).

The eroded underside of the breccia passes smoothly onto the dolomite wall, suggesting that a gently flowing current of water fashioned this surface.

Two dome shaped cavities (less than 1m deep) which have developed upwards into the pinkish breccia exposing, in one dome, the carapace travertine which caps the breccia body (Fig. 5.4). These domes seem to have been caused by eddies in flowing water. However, they may also represent the 'enlargements' which Bogli (1971) claims are the result of mixing karst waters. In either case the domes suggest currentflow, even though the flow must have been gentle (fragile bones protrude from the dome walls).

Other smoothed surfaces can be seen near the pendants in Lincoln's Cave. Stalactites have been eroded out leaving hollows (0,2m deep) with smooth surfaces: these surfaces often pass evenly onto the dolomite roof or wall. In a chamber south of Elephant Chamber (point 5, Fig. 5.1), travertines have been eroded flush with the mud and dolomite walls.

5.3.3 Grooves

The Mound breccia is attached to a 13m vertical dolomite wall which is unadorned by travertine deposits. The surface of this wall is slightly grooved horizontally over much of its surface. The grooves are clearly evidence of differential solution which may either result from weaker beds or from current concentration at declining levels since the wall is aligned along the strike exposing dolomite strata horizontally, or of vadose stream erosion.

This concludes the survey of erosional features encountered in the cave system, and indicates the majority to be phreatic.

CHAPTER 6 - CAVE DEPOSITS

6.0 Little of the cave system has escaped modification by various deposits. The deposits described in this chapter may be divided into two groups, calcareous and non-calcareous: the modes of deposition of each are entirely different and thus give rise to distinct features. Furthermore, the volume of the calcareous deposits (secondary and tertiary calcium carbonate) is small compared with the large non-calcareous deposits which, often surface derived, have modified the original cave voids dramatically.

A model of debris cone development is presented as a basis for descriptions of the various large debris bodies encountered in the cave system. The location of these bodies within the system is examined but the spatial relationship between them is discussed in Chapter 8.

6.1 Secondary and Tertiary Calcium Carbonate Deposits

6.1.1 Stalactites and Related Formations

Stalactites are best developed in the large caverns and high passages along the structural control line. Few have survived the mining however. Some of the broken remnants have diameters of 0,5m.

Stalagmites are seldom seen, either because they did not form, or because they were easily removed. However, in the low-ceilinged, inaccessible Ravjee Cavern, pillars of travertine can be seen. Pristine calcite straws and helictites are abundant in Ravjee Cavern. Straws and helictites are forming today and a 'younger generation stalactite' has been dated by carbon-fourteen dating (stalactite outer wall: greater than 50 000 years before present, inner wall greater than 47 500 years before present - Vogel, 1971).

FEATURES	RE-SOLUTION LEVELS (METRES ABOVE THE LAKE)
THICK FLOWSTONE WITH TERTIARY GROWTHS	±8m
THICK REDISSOLVED FLOWSTONE WITH WITH TERTIARY GROWTHS	5m
THIN REDISSOLVED FLOWSTONE WITH TERTIARY GROWTHS	2,3m
THIN REDISSOLVED FLOWSTONE	1,5m
BARE DOLOMITE WALL	0 (LAKE)

Fig. 6.1 Re-solution levels on Milner Hall flowstone indicating past lake levels

Stalactites often merge into flowstone deposits, and the two forms generally occur together. Thick (1m) flowstone deposits have been mined at several points in the cave system, especially in the Daylight, Exit and Elephant Chambers, and the Fossil Cave.

A flowstone, too thin to be mined, covers the entire south wall of Milner Hall and has become a tourist attraction. A travertine curtain, high in the roof of Milner Hall and a large stepped flowstone beneath Entrance 1 are some of the only stalactitic formations of any size which remain in the cave.

Re-solution has affected many of the wall deposits, at the lower levels especially. The characteristic honeycombed and pitted surfaces are evidence, and various earlier lake levels can be discerned where subaereal calcite deposition ends, and re-solution begins (Fig. 6.1).

6.1.2 Calcite Floors

These can be seen overlying lake deposits as a crust in various parts of the cave. Notable is that beneath Entrance 1, that at the entrance of Terror Chamber, and that in the recesses of the Graveyard. The calcite floors are less than 3cm thick and little remains of them now (at best $1m^2$ in areal extent). Carapaces merge into floors in places.

6.1.3 $CaCO_3$ Crystals

Aragonite crystals occur on most walls in the cave system, whether dolomite, chert, travertine or cave earth. They can be as much as 2 - 3cm long, mostly of aragonite, and probably some of calcite. Subaqueous aragonite (cauliflower aragonite) occurs on the wall of Milner Hall. Concoidal amorphous calcium carbonate may also coat some walls.

6.2 Non-Calcareous Deposits

These deposits consist of residual wad, internally and externally derived earths, talus and collapse debris. Breccias, formed by the cementing of these deposits, are included here, since the mode of origin is essentially the same.

Although both are found in characteristic cone form, the internally and externally derived non-calcareous deposits are distinguished for the following reasons:

Firstly, the constituent materials are different due to the two distinct sources from which they derive: the externally derived deposits consist predominantly of large quantities of fines (red soil, often layered), whereas the internally derived deposits consist mainly of collapsed chert ledges.

Secondly the externally derived deposits are very large in volume compared with the internally derived.

Thirdly, the presence of externally derived material indicates that a chamber has become connected to the hillside, an important fact when analysing the development of the cave system.

6.2.1 Internally Derived Deposits

(1) Wad is an insoluble residue of manganese oxide which remains as a coating on dolomite walls which have been subjected to solution by karst waters. It is thus found below the present water-table, and in the paraphreatic zone (on walls bounding the Lake and the water bodies 2, 3, 4 and 7, and sump 4 - Fig. 4.3), and in the vadose zone (on dolomite blocks[1] buried in moist, uncompacted gravels e.g. in the Elephant Chamber - point H, Fig. 5.1).

Wad is encountered as a black fine powder, or as a moist, water-retentive, jelly-like substance. Its presence indicates static (or very slowly circulating) water conditions, or it indicates adjacent

[1]Maximum thickness of wad observed on cave walls is 2cm, as opposed to a maximum of 5mm on buried dolomite blocks.

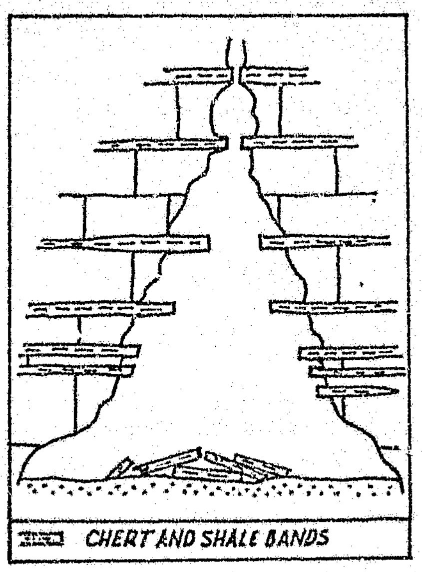

Fig. 6.2 Collapse debris beneath major joint, Ravjee Cavern

moist earth. Wad is found cemented into breccia, with discrete impregnations of crystalline calcite, usually at the base of larger bodies of breccia, e.g. beneath the Fossil Cave breccias and in the Milner Deposit.

(2) Collapse Deposits

These are found mainly in the inner recesses of the system, especially in the northern passages, since the externally derived deposits have obliterated any such features that may have existed near the present-day avens and connections with the surface.

Collapse material can thus be seen near the water bodies of all three caves in the system. They form banks of debris against the walls from which chert and shale ledges have fallen, or they form mounds beneath vertically extending joints (point M, Fig. 5.1 and Fig. 6.2), usually with little fine matrix material.

Of a different order altogether are the very large dolomite blocks which have collapsed from the roof. The largest (7m long, 5m high, 4m broad) is that at the convergence of Milner Hall and Elephant Chamber (point N, Fig. 5.1) which fell a distance of 3m. The Name Chamber is formed by the collapse of a large block which now forms the floor of the Chamber (point K, Fig. 5.1). In Lincoln's Cave, a large collapse block lies in the main chamber, and others lie on top of one another, wedged in the narrow eastern passage (point P, Fig. 5.1).

Blocks of collapsed breccia have fallen from the weakened Terror Chamber roof, and they also occur in the rubble blocking a passage on the south side of Elephant Chamber (point 3, Fig. 5.1).

6.2.2 Externally Derived Deposits

These large deposits, which have affected the interior morphology of the caves so greatly, are considered in several broad groups (6.2.2 (1) - 6.2.2 (10) below). Each group appears to be a continuous

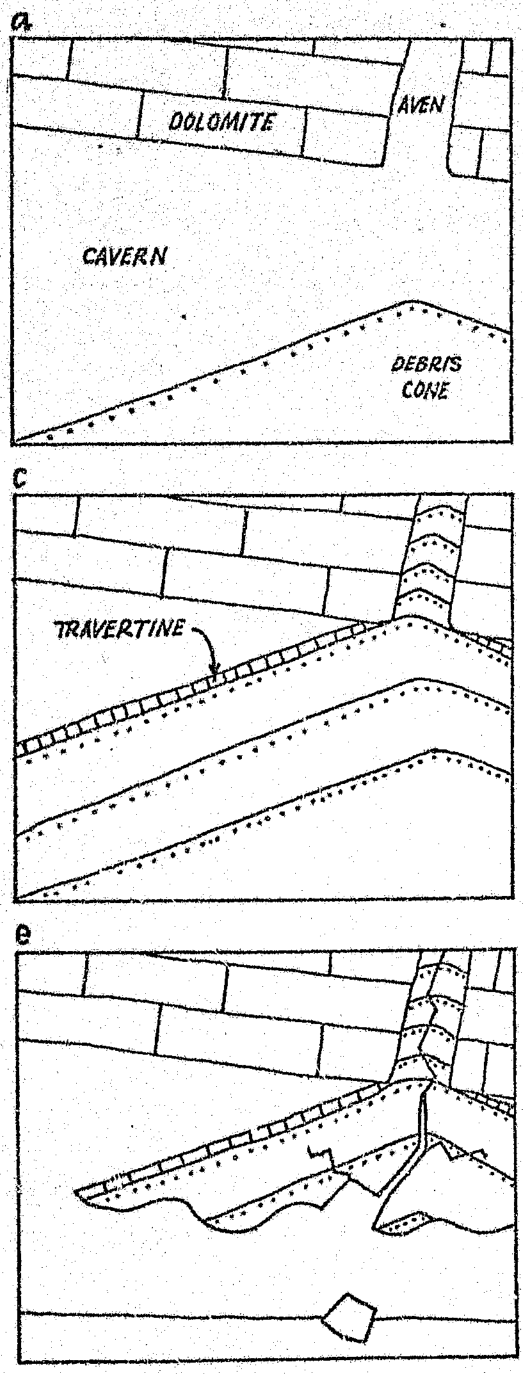

Fig. 6.3 Typical stages in the development of Sterkfontein cave deposits (see text)

mass (except (8)) consisting of various materials, sometimes laid down in a number of phases, but derived nevertheless from the same aperture (or aperture cluster) in the cave roof. The constituents range from mud and soil to gravel, stones and boulders, which have been cemented into breccias of varying hardness. Bone fragments occur, with occasional pockets of high bone concentration.

It is significant that no deposits corresponding to those termed 'clay fill' by Bretz (1942)[2] have been encountered at Sterkfontein.

To aid the description of the ten main debris bodies, a model of debris accumulation in Sterkfontein is presented. Although the model is derived by consideration of these debris bodies, it is nevertheless presented first as an explanation of the particular set of accumulation characteristics encountered, and also as an object against which the individual debris bodies may be compared.

Debris Cone Model

A debris cone grows upwards by the accumulation of debris beneath an aven connected to the hill surface (Fig. 6.3a). When the mound attains the height of a hanging dolomite wall (sometimes the ceiling of the underground chamber), it can grow no higher downslope of this interruption (Fig. 6.3b). Any surface material which enters after this stage has been reached will fill the aven and not the cavern below (Fig. 6.3c).

Any protrusion from the cavern roof will have a similar effect: downslope of the protrusion the cavern will be protected from further infilling; upslope the cavern will fill with debris (Fig. 6.3d).

If debris enters with calcium carbonate-charged water percolating

---

[2]Externally derived clay material laid down during the phreatic phase in static water-bodies seldom showing any signs of lamination, current flow or turbulence.

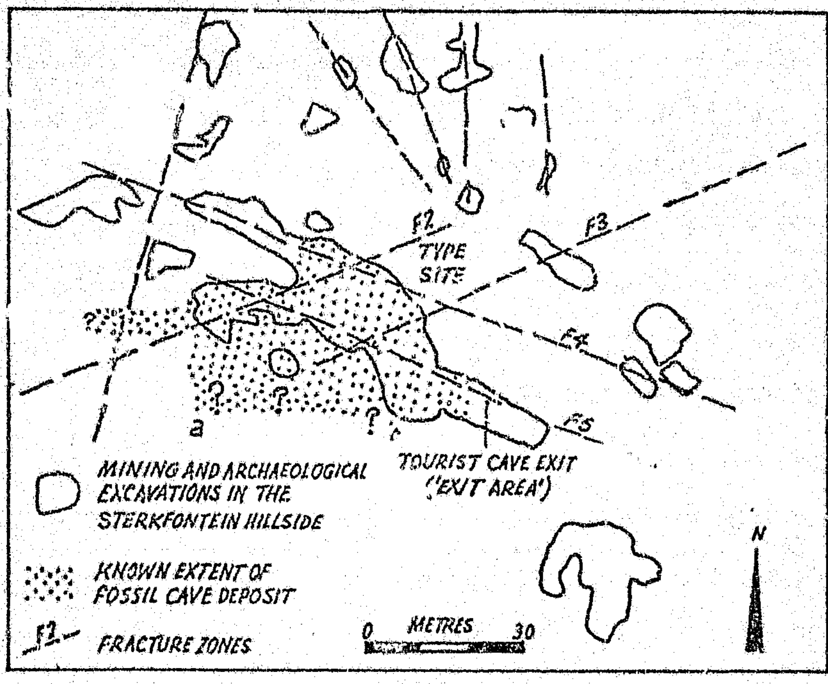

Fig. 6.4 Plan of Fossil Cave Deposit as exposed by excavation

through it, it is cemented into a breccia. However, the supply of percolating water does not cease when the supply of surface debris is halted downslope of a hanging wall. The water thus precipitates a travertine carapace on top of the now static debris-cone talus slope (Fig. 6.3c). Later, the solidified breccia may be disturbed or removed (Fig. 6.3e) - especially by re-solution and consequent collapse (due to both rising ground water and aggressive percolating surface water), to the extent that the cone in the underground chamber is supplied actively once more with surface material or decalcified breccia (Fig. 6.3f).

Of the ten deposits described below all except the Fossil, Terror, Entrance 6 and Fault Deposits (Nos. (1), (3), (8) and (10) below) show these controls and sequences in their development.

(1) Fossil Deposit

The rich bone and artefact content of this deposit exposed at the surface in the Fossil Cave, has long been known and is at present being further investigated. The mode of accumulation of the deposit has been carefully examined (Brain, 1958; Robinson, 1962; Brink and Partridge, 1970), and a general description of it is given here.

The Fossil Deposit has been exposed from the Tourist Cave Exit Area to the Extension Site, and extends 17m further westward (A.R. Hughes, personal communication) (Fig. 6.4). To the north it is bounded by the north wall of the Fossil Cave (a small displacement fault - fracture zone No. 4); to the south its exact extremity is not known, but it outcrops in several places south of the excavations as far as the east-west line a - b (Fig. 6.4).

The deposit consists of four distinct breccias, a thick travertine (which has been mined), and unconsolidated pockets of bone rich soil, possibly a decalcified breccia (Brink and Partridge, 1970). The two main breccias are a collapse breccia and an overlying pink breccia of slow

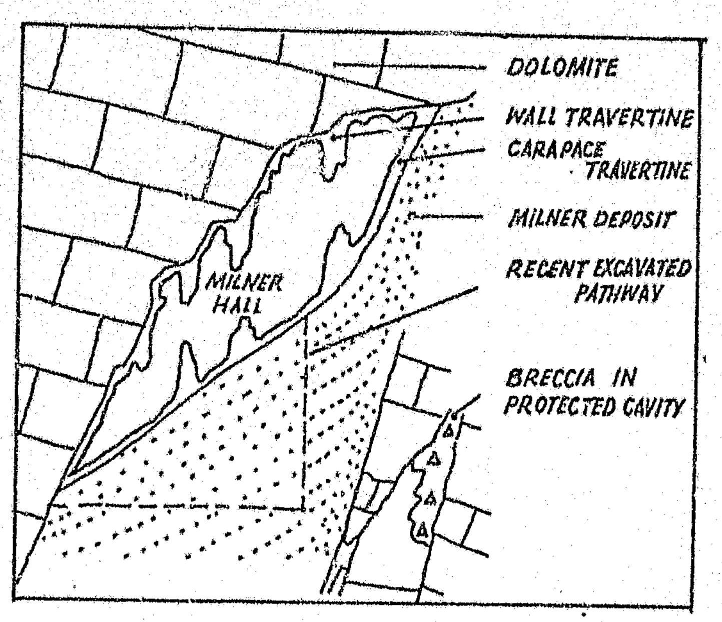

Fig. 6.5 North-south section through Milner Deposit, showing inundation of Milner Hall

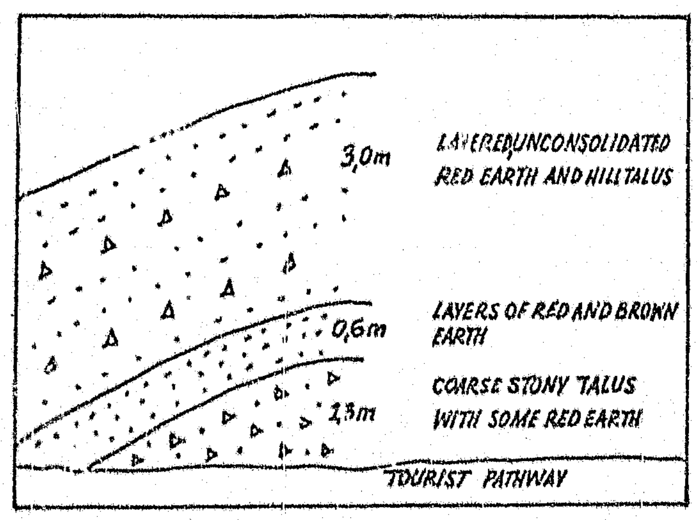

Fig. 6.6 Section exposed by pathway in unconsolidated mound debris cone, Milner breccia

accumulation. The first of the australopithecine skulls was recovered from this contact zone (Fig. 6.4).

The control by four of the major lineaments of the area, on the development of the Fossil Cave, and hence of the extent of the deposit is apparent (Figs. 5.1 and 6.4).

(2) The Milner Deposit

This stretches from the Lake in Milner Hall to point L (Fig. 5.1) a distance of 100m. The western half of the deposit in Milner Hall covers the entire north wall (13m high), reaching the highest parts of the roof (Fig. 5.1, A-B), from where it apparently entered the Hall. This deposit consists mainly of partly consolidated red earth lumps, and small stones, laid down in layers dipping downslope. It appears to be hill talus which has collapsed or slumped down into the Hall. Stalagmites and a thin travertine carapace deck the steeply sloping surface (39^{0}) of this unconsolidated deposit. A 3m face has been cut into this mass, as a tourist path, and the floor levelled. It is apparent, however, that this deposit originally banked against the opposite wall at a higher level than at present since remnants of the carapace cover can be seen on this wall (Fig. 6.5).

This part of the Milner Deposit contains some masses of breccia. Their relationship to the unconsolidated deposit is not clear as they occur in an adjacent side chamber (Figs. 5.1 and 6.5 - point G).

Towards the eastern end of Milner Hall, the Milner Deposit becomes a very large debris cone (20m high) termed the 'Mound' (point J, Fig. 5.1). This cone can be traced beyond K to L (Fig. 5.1) and forms the eastern half of the Milner Deposit. At J the Mound consists of unconsolidated and partly cemented layers of red earth lumps and hill-talus (as far as it can be ascertained from a 5m section cut into the side of the Mound - Fig. 6.6). One to 2m above this loose debris, a travertine

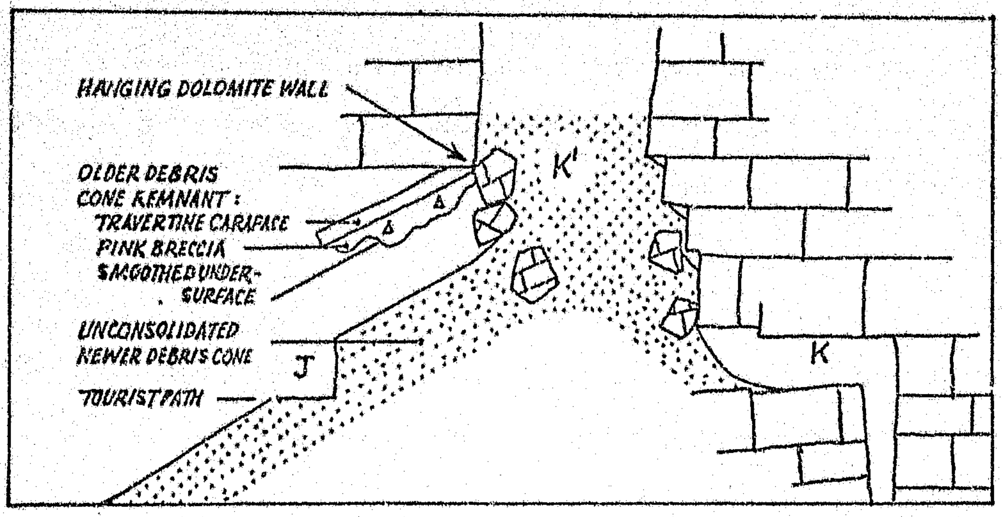

Fig. 6.7 East-west section from points k-j (Fig. 5.1) showing relationship of new deposit to old, and the effect of hanging walls

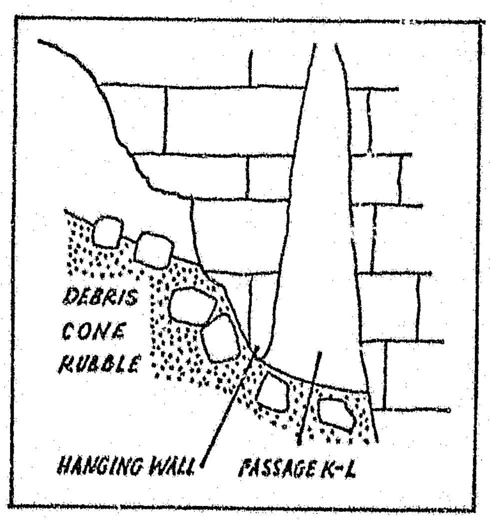

Fig. 6.8 Section showing passage k-l (Fig. 5.1) protected from debris influx by a hanging wall

carapace (13cm thick) overlies a hard pink breccia (the 'Mound breccia'). This carapace and breccia are attached to the dolomite chamber wall (Fig. 5.3) and rise towards the apex of the cone, where cone and carapace meet (Fig. 6.7)[3] The sequence of accumulation and removal evident here appears closely akin to the model proposed.

K' is the highest accessible point on the large Milner Deposit cone. From K' there is a view of Milner Hall and the cutting at Point J. Being on the upslope of a hanging dolomite wall, K' is situated among large collapsed boulders of dolomite and breccia, coated with red soil - of the newer, post-carapace phase of accumulation. It is interesting to note that the hanging dolomite walls have contributed to the size of the blocks permitted to enter into Milner Hall (at J) and the Name Chamber (K). The space between the newer debris and the hanging walls is insufficient to allow the passage of the larger blocks. The result is that comparatively fine debris reaches J and only red soil penetrates into the Name Chamber (K).

From K to L a similar effect can be seen. The passage K-L passes, in effect, along the side of the debris cone. As at K, a low hanging wall prevents boulders from invading this passage (Fig. 6.8).

The coincidence of the Milner Deposit as a whole with the major lineaments of the area is apparent (Fig. 5.1).

(3) Terror Deposit

This deposit, visible in the Terror Chamber, is probably the largest single accumulation in the cave system. Its volume is relatively easily gauged since evidence of both its horizontal and vertical extent exists.

---

[3]The capital letters - J, K, K', - in the following paragraph refer to Fig.6.7

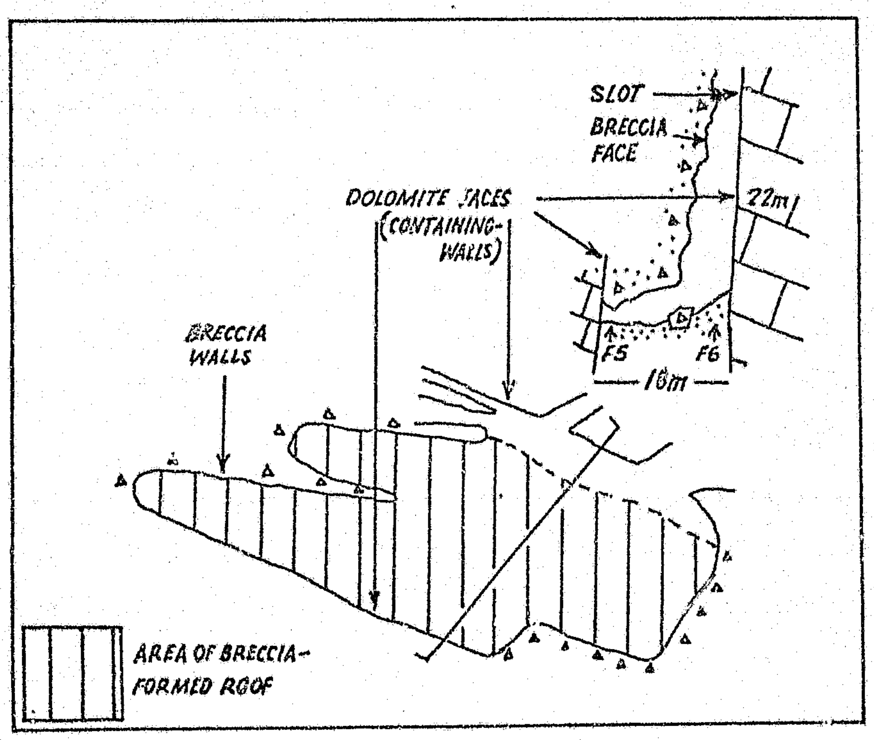

Fig. 6.9 Plan of Terror Chamber showing area of breccia-formed roof and position of vertical dolomite containing walls

The entire Terror Chamber (60m by 18m) has developed as a collapse void within the deposit mass which straddles fracture zones 4 and 5, and the area between. Fracture zones 2 and 3 intersect 4 and 5 in the centre part of the chamber (Fig. 5.1). Since dolomite bedrock is absent in the intersection area, it may be assumed that fracture zone cavities widened by phreatic erosion and finally coalesced to form a large chimney-like cavern. The dolomite walls of this cavern are visible on the north and south sides of the Terror Chamber (Fig. 6.9).

Generally a low (4m) collapse void, the Terror Chamber ascends vertically 22m in the form of a narrow slot in the vicinity of the north wall. The slot gives some indication of the vertical extent of the original chimney-like void. The sheer dolomite face of the north wall forms one side of the slot and the cemented deposit mass forms the other (cross-section, Fig. 6.9). The deposit may be regarded therefore as the filling of a large vertical void centred on the intersection of four fracture zones.

If the Terror Deposit once filled the large vertical void as suggested, then the existence of the abovementioned slot - between the containing bedrock wall (north wall of the Terror Chamber) and the deposit - needs to be explained, since the deposit presumably accummulated against this wall.

The likliest explanation is that aggressive meteoric water percolated through the deposit mass causing decalcification of the breccia along the bedrock-breccia contact. The breccia was gradually removed leaving a large unsupported breccia wall from which many blocks have collapsed. The decalcified debris was deposited in the Terror Chamber beneath the slot.

A shallow shaft, which connects the top of the dolomite wall to the Exit Area, probably guided the aggressive water from the surface.

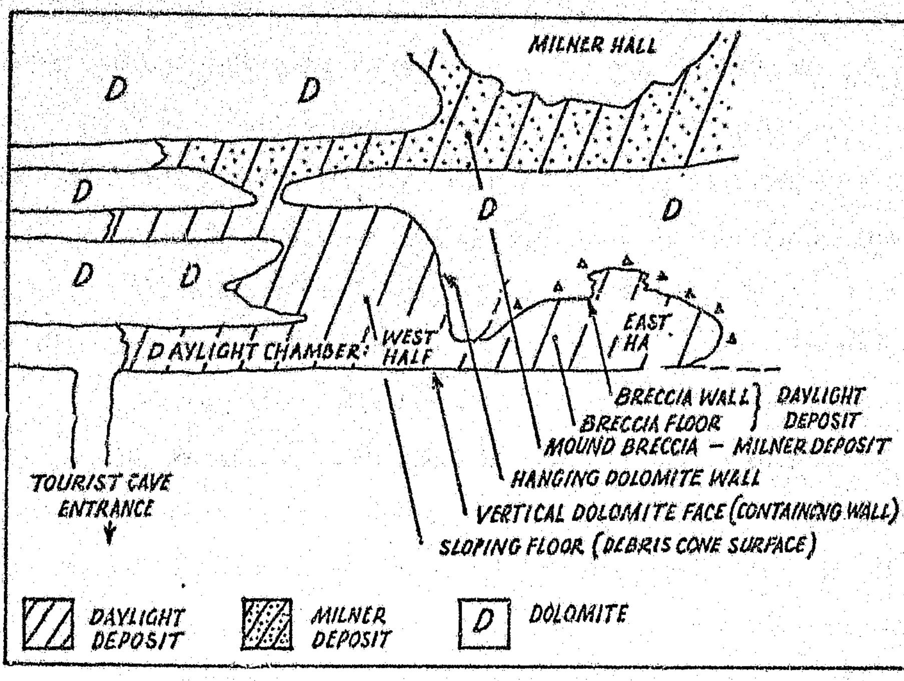

Fig. 6.10 Plan of Daylight Deposit and part of Mound breccia (Milner deposit)

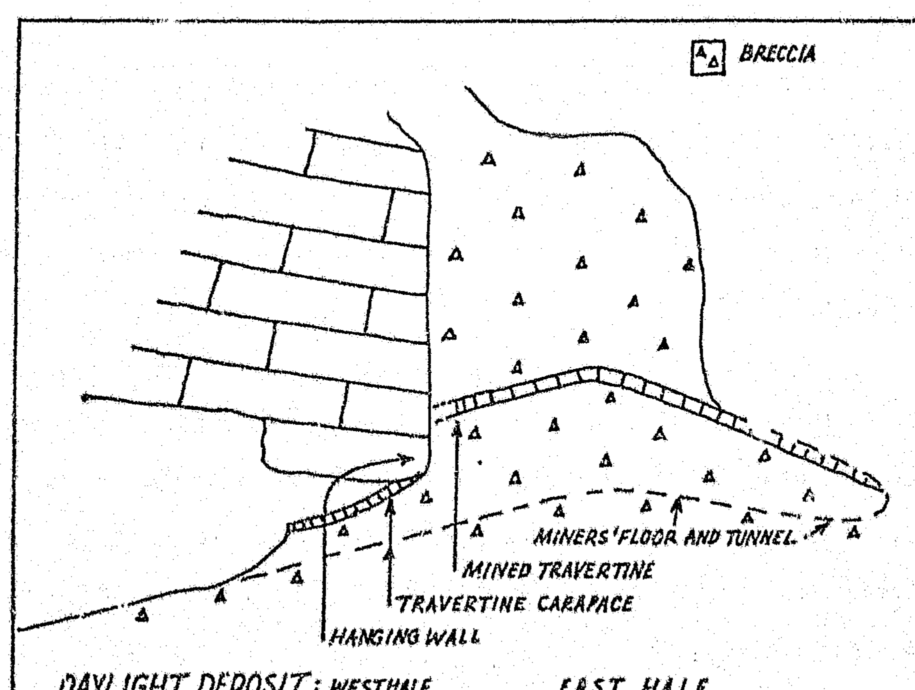

Fig. 6.11 East-west section through Daylight Deposit

A similar situation exists in the Daylight Chamber where the Daylight Deposit beneath Entrance 3 has been eroded away from the vertical dolomite containing wall to form a slot with opposing dolomite and breccia faces.

The influence of hanging walls on this deposit is not evident. This is understandable since the deposit is a slot filling and not a debris cone. Nevertheless an influx of younger material debouches into the west end of the Terror Chamber in the form of a small (2m high) breccia cone capped with a travertine carapace. The breccia roof of the Chamber, acting as the controlling hanging wall, has limited the amount of material entering the Chamber.

It is difficult to ascertain the form and composition of the Terror Deposit since the ceiling of the Terror Chamber is covered by a thin flowstone. However, some small pockets of bone, and a recurring pink sandy matrix have been encountered along the walls and at points on the ceiling. Few large block inclusions occur and the cementing of the deposit appears to be spasmodic: uncemented pockets of red earth are visible in places. The lack of uniform cementing helps explain why the deposit has collapsed over such a large area.

(4) Daylight Deposit

This deposit, mainly a breccia, forms the floor and part of the north wall of the Daylight Chamber (Fig. 6.10). The effect of a hanging dolomite wall is strikingly demonstrated in the formation of this deposit: the west half of the Chamber has a low roof of dolomite, and a sloping floor of travertine overlying a breccia cone (Fig. 6.11). The east half however, is a slot with a high roof (15m); the vertical north wall (a partially mined face) of this half is formed of breccia, and the vertical south wall of weathered dolomite bedrock (Fig. 6.10).

The dolomite buttress separating the west half from the east half has limited the amount of debris flowing into the western half of the Chamber.

The breccia mass in the eastern half may have been even larger than it is today. As in the case of the Terror Deposit, it seems very likely that breccia originally filled the slot (eastern half) completely, resting against the present-day dolomite wall on the south side of the Chamber. It seems that the breccia was removed from the southern side of the Chamber by aggressive rain water entering on this side of the Chamber from the apertures above (Entrance 3).

The morphology of this breccia indicates a stage of development prior to the influx of a younger debris mass (Fig. 6.3e).

The breccias consist of a fine sand with very few stone inclusions. At the back of the excavation, against the dolomite wall, small collapse blocks of dolomite can be seen. A mined flowstone, decalcified pockets and fossiliferous layers can be seen in this breccia. The flowstone and underlying breccias form the apex of a cone, visible in the mined face, which indicates that the debris inlet was in this vicinity during the time of accumulation, that is, near to or at the present-day aperture in the Daylight Chamber roof (Entrance 3).

The Daylight Deposit occupies a lineament (Fig. 5.1) and lies directly above part of the Terror Deposit (see 8.2.1 below).

(5) Large Exit Deposit

In the Exit Chamber a large mass of breccia lies along the eastern wall (Fig. 5.1). In form this deposit is similar to the 'Mound' debris cone (Milner Deposit): a talus slope, consisting of a hard pinkish breccia slopes down from the roof of the Chamber. It is covered by a travertine carapace, mined in places and has been heavily attacked on its underside by phreatic solution. Issuing out from beneath the phreatically eroded undersurface is a newer unconsolidated talus slope which appears