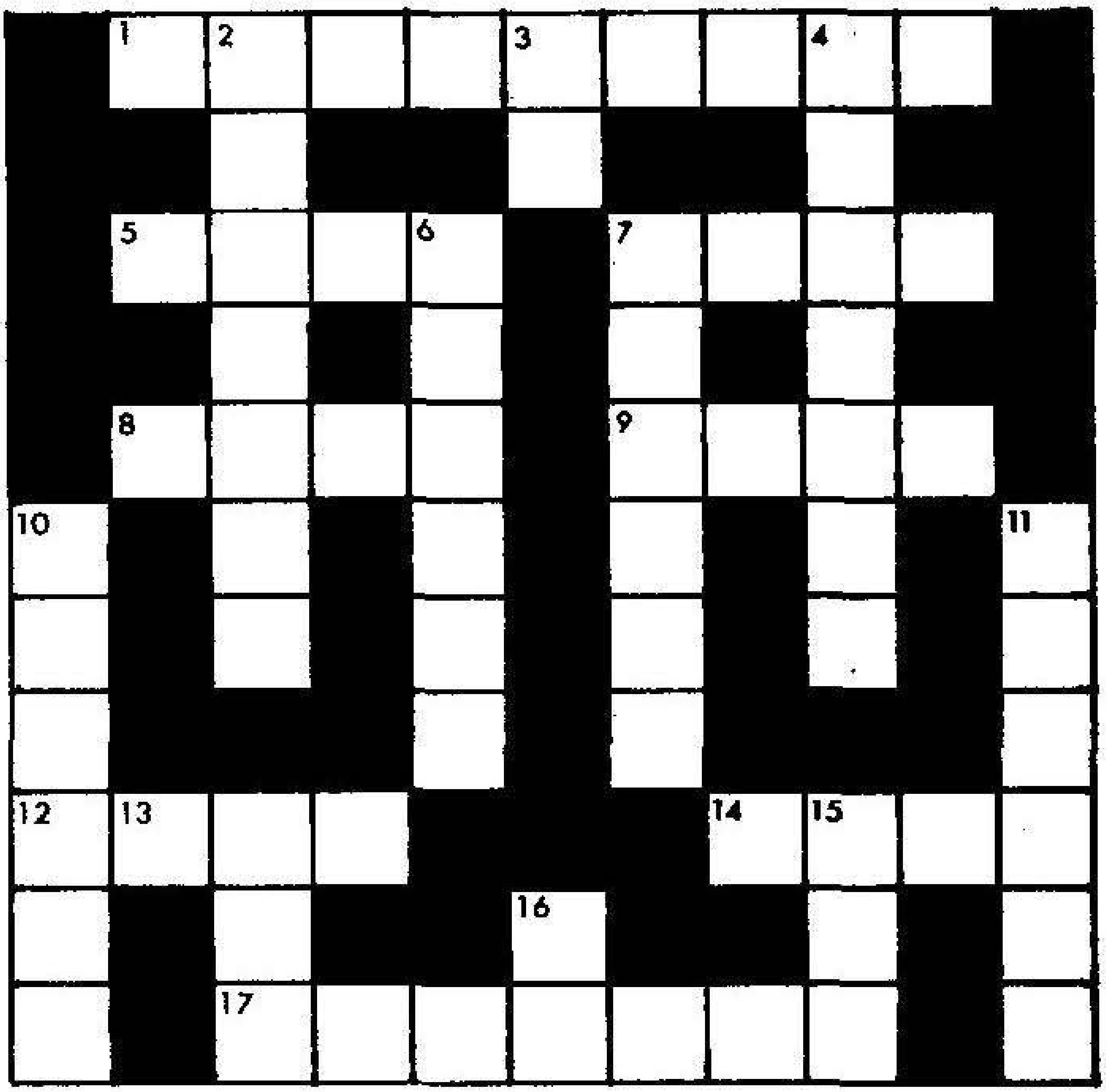
Journal of The Farnham Geological Society

Volume 1 December 1983

Cross Bedding

Crossword with a geological bias set by Colin Brash.



CLUES ACROSS

1. Arenaceous Deposit
5. Earliest Jurassic strata
7. These start horizontal
8. Can be split into thin layers
9. Mud suspended in water
12. Attracted by a magnet
14. Evaporite
17. Between Peat and bituminous coal

CLUES DOWN

2. State of being dry
3. Elementary chips
4. In the form of small lumps
6. Consolidated 9 across
7. Dark basic rock
10. Formed by the sea
11. Billy's SST
13. Trapped in pockets
15. How old is it?
16. Element of non magnetic metal

Cover illustration by Audrey Price

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contents

A Special Mention

The Editor and all the contributing authors would like to thank Yvonne Gilfrin and Lyn Linse for their mastery of the new word processing techniques. Without their long hours at the keyboard, the typesetting of this Issue would have presented considerable problems. Our thanks are also due to Peter Bower whose excellent artwork again fills these pages and to the Journal Sub-Committee for their interest and expertise in proof-reading the submitted copy.

Soil erosion on the Lower Greensand near Hascombe, Surrey, 1982-3

John Boardman

In 1982-3 gullies and fans developed on sandy soils of the Frilford association on agricultural land near Hascombe. The estimated rate of soil loss is 31 t/ha for an area of 16.8 ha. Factors responsible for the erosion are, above average rainfall, erodible soils, high-angle convex slopes, limited crop cover during the winter, and the movement of water through field boundaries.

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1. INTRODUCTION

Soil erosion on agricultural land in Britain is not usually considered to be a problem. This is because of the well-vegetated character of the landscape and the low rainfall intensities. However, in recent years, detailed surveys of some parts of the country have shown erosion to be widespread (Read, 1979), and isolated examples of very serious erosion have been recorded (Evans and Nortcliff, 1978; Boardman, 1983).

Erosion on agricultural land in Britain occurs on almost all soil types, on gentle slopes, and on slopes of less than 25 m length (Evans, 1980). *Low rainfall intensities have also been shown to* initiate erosion where crop cover is slight (Reed, 1979). Data from about 600 eroding sites suggest that erosion is most likely where fields contain wide crestal areas above a slope convexity, the crest acting as a storage areas for water which, once infiltration capacity is exceeded, flows downslope and incises into the convexity (Evans, 1980). The removal of field boundaries has created large fields often from slope crest to valley bottom. At many sites, erosion has been the result of farming practice, particularly the working of the land down the maximum slope and the creation of wheelings by agricultural vehicles.

There is some evidence that a recent move to the growing of winter cereals, rather than spring cereals is responsible for erosion in areas previously unaffected. Thus, fields are susceptible to erosion throughout the autumn and winter period when crop cover is low (Boardman, in press).

2. *THE HASCOMBE AREA: GEOLOGY AND TOPOGRAPHY*

Soil erosion was recorded around Little Burgate Farm, 1.5 km west of Hascombe, Surrey, in June 1983. The area is on the dip slope

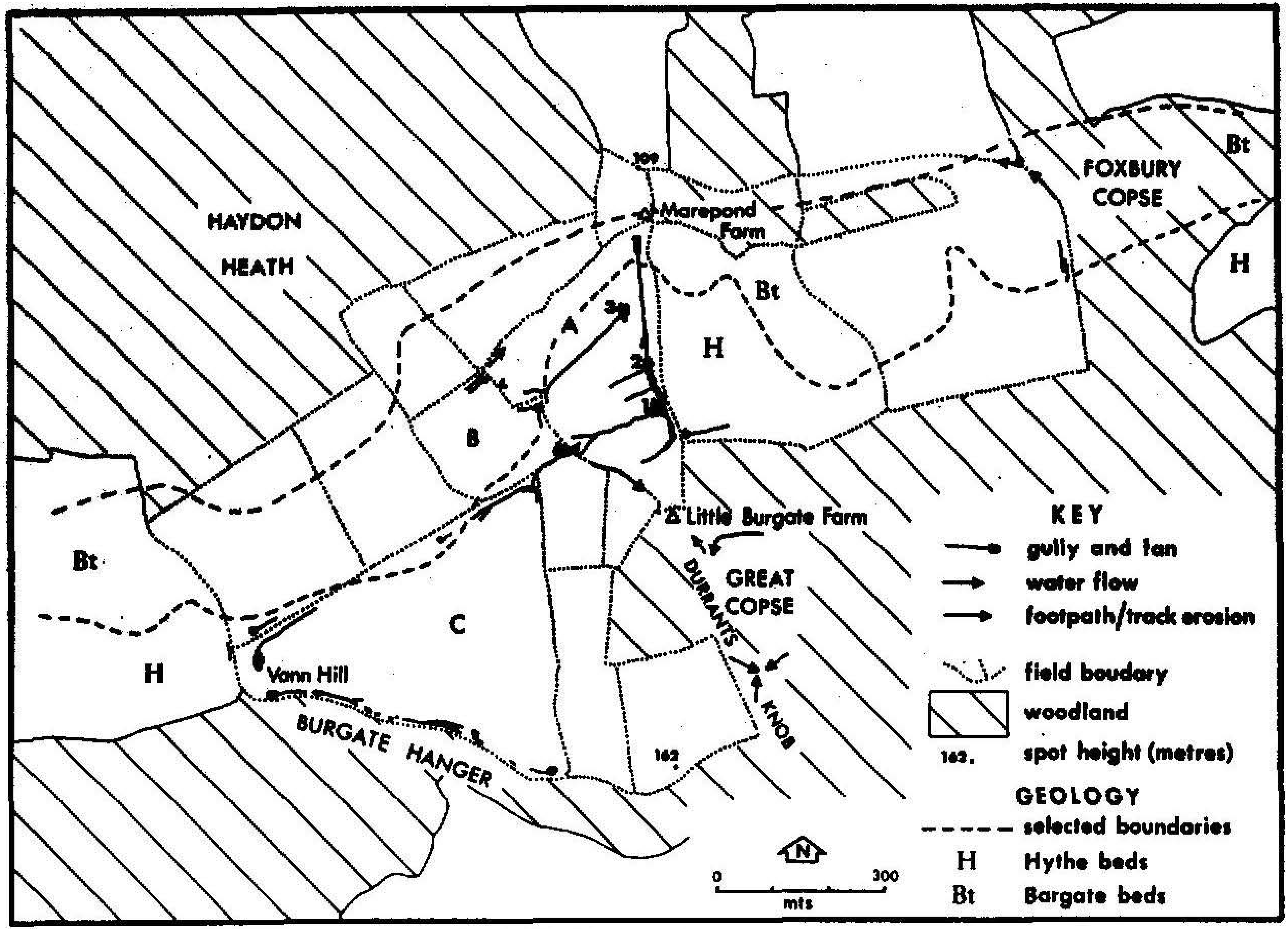

Figure 1 SOIL EROSION NEAR HASCOMBE 1982 - 83

of the Lower Greensand (Cretaceous) escarpment, the highest point of which is 162 m, 500 m south of Little Burgate Farm (Figure 1). Hythe beds are succeeded to the north by Bargate and Sandgate beds and the higher ground of Hydon Heath is underlain by Folkestone beds. The lithology of the two units on which erosion occurred is described as follows: Hythe beds - fine-grained, glauconitic sand and sandstone with some cherty beds; Bargate beds - glauconitic sands with calcareous sandstone doggers, some chert and quartz pebbles to 6.3 mm diameter (Thurrell et al., 1968).

The dip slope of the escarpment is dissected by dry valleys such as that which runs northwards through Little Burgate Farm to Marepond Farm.

3. SOILS AND LAND USE

Soils around Little Burgate Farm are grouped as the Frilford association: the dominant soils being those of the Frilford series. These soils are medium or coarse sandy passing to sand or sandstone at between 0.8 and 1.2 m (Mr. S. J. Fordham, pers. *comm.*). *Such soils are classified as argillic brown sands* (Avery, 1980) and are a subgroup of well-drained sandy soils with a clay enriched B horizon.

Much of the Lower Greensand escarpment is forested but between Hascombe and Hambledon is an area of arable cultivation which in 1982-83 was under either winter or spring barley.

4. RAINFALL 1982-83

In south east England the last three months of 1982 were unusually wet and resulted in erosion at many sites on the South Downs. Analysis of the rainfall record for the Hascombe area is, however, of little value since the precise time of erosion is unknown.

5. PREVIOUS SOIL EROSION

Little information with regard to erosion in this area is available, particularly as it proved impossible to contact the farmer of the affected fields.

Thurrell et al. (1968, p 139) note the problem of soil erosion by 'sheet flooding' after storms in the Lodsworth area (SU 9223). During soil mapping of the nearby Whitley Park area (SU 923395) in August 1980, Fordham recorded no erosion of any consequence, probably because all moderate to steep slopes were well grassed; however, gullies up to 0.4 m deep were noted on arable land at Tuesley Farm (SU 970415) and near Suffield Farm (SU 925473) (Mr. S. J. *Fordham, pers. comm.*).

On similar Lower Greensand soils in two areas of West Sussex soil erosion on agricultural land is a regular, probably annual, event: these are areas around the villages of Easebourne (SU

8922) and Albourne (TQ 2616) (Boardman, 1983).

Prilford association soils are recognised as being subject to risk of water erosion and nationally they cover about 230 sq.km. (Mackney et al., 1983).

6. EROSION AROUND LITTLE BURGATE FARM

Erosion was first noted about 20 April 1983 (Mr. I. M. Fenwick, pers. comm.) and the author visited the area on 6 and 20 June when measurements of fan volumes and gully dimensions, together with a survey of a wider area, were carried out.

TABLE 1: Estimate of Erosion at Little Burgate Farm

Field	Area	
	sq.km.	ha
A	0.089	8.9
B	0.050	5.0
C	0.029	2.9
Total	0.168	16.8

Fan	Area	Vol.*
	sq.m.	cu.m.
1	885	177
2	625	125
3	500	100
Total		402 (= 522.6t**)

Soil Loss = 23.9 cu.m./ha

= 31.1 t/ha

* assumes mean depth of 0.2 m

** assumes bulk density of 1.3

West of Vann Hill, to the village of Hambledon, no erosion was recorded: it is significant that this area was predominantly under spring cereals (Figure 1). At the time of the survey erosion of footpaths and bridleways in the forested areas was occurring. Material from paths in Durrants Knob, Great Copse and Foxbury Copse had been washed onto roads; this aspect of erosion in the area was not investigated in detail.

The major feature was a series of fans and gullies in field A (Figure 1). Fans were located along the valley bottom and the two principal gullies were developed along small depressions in the valley-side slope. The approximate length of the gullies was 250 and 180 m respectively. Maximum slope length within the field is 420 m and maximum slope angle is 12 degrees; relief within the field amounts to 21 m. Field areas, fan volumes and soil loss per unit area is given in Table 1.

Water flow and transport of sediment had occurred from field C into the adjacent lane and from there into field A (Figure 1); likewise, water had passed from field B to A. Thus, areas contributing sediment to the fans in field A could not be precisely defined. Calculations of loss per unit area have therefore assumed that all of fields A and B, and about 25% of field C, have contributed to the sediment in the fans in field A. Soil loss is, locally, much higher than the 31 t/ha calculated: this is a mean figure for an area of 16.8 ha. A second reservation with regard to the estimate of loss per unit area is that it is based on measurement of the three major fans: smaller areas of deposition are ignored - the total could, perhaps, be increased by 20%.

A sample from undisturbed A horizon of soil adjacent to the main gully above fan 1, was sieved: 94% was sand (2 - 0.063 mm), 6% silt and clay (<0.063 mm). The sand percentage in a sediment sample from the surface of fan 1 was 97%. Thus, little silt and clay was available to be moved in suspension: the mapped areas of sand deposition probably account for most of the eroded material.

As a check on estimates of fan volumes, soil loss from the main gully above fan 1 was calculated. Cross-section measurements were made at 18 points along its 180 m length. Greatest depths and widths were 1.5 and 2.0 m respectively. Total soil loss amounted to 152.2 cu. m. or, about 200 t. Small rills and gullies tributary to the main one were not measured and therefore the estimated volume of soil in the fan (177 cu. m.) appears to be reasonable. Material deposited in fan 2 must also have passed through fan 1: Figure 1 shows that sources other than the main gully would also contribute to these two fans.

In other parts of field A signs of erosion were also observed; particularly in the headlands along both east and west boundaries. Build-up of soil behind the thick hedge separating fields A and B was noted at three points (Figure 1). Water flow and sediment movement from field B to A was through a gate in the hedge. Erosion in the northern part of field C was concentrated along vehicular wheelings. In the north-western corner of the field was a fan with an estimated volume of 60 cu. m.

In field A drill lines of the winter barley were down the maximum slope. The influence of this direction of working must be a matter of conjecture with reference to the initiation of erosion since the crop was already 0.3 m high when the survey was carried out.

7. DISCUSSION

The characteristic size of soil particles moved onto the fans is about 0.1 mm. Water velocities of around 20 mm/s are required to entrain such particles (Hjulstrom, 1935). Overland flow on agricultural land probably rarely attains these velocities. Detachment of loosely bound soil particles will result from raindrop impact, entrainment in surface water will follow and deposition will not occur until velocities fall to around 6 cm/s. In fields under winter cereals water flow is concentrated along wheelings and drill lines which provide relatively efficient low-roughness channels. Turbulent erosion flow takes place where flow is confined and incision of rills and gullies occurs at points where the critical velocity for turbulent flow is exceeded (Evans, 1980).

Erosion on the scale recorded at Little Burgate Farm is, in the short term, a serious inconvenience to farmers involving crop and fertilizer loss and difficulties in working the fields. It is of little consolation that most of the eroded soil travels short distances. Excessively thick valley-bottom infills cover small areas whereas much of the eroded soil is organic-rich, A horizon material from large areas of the valley-side slopes. This is less true at Little Burgate Farm where two deep gullies formed, than at most sites of erosion on agricultural land. In the long term, losses such as those recorded here, far exceeded rates of soil formation and therefore lead to deterioration of soil quality and decline in crop yields. Morgan (1980) suggests a rate of soil loss of 2 t/ha/yr as being 'acceptable' for sandy soils in southern England. This, however, may be too generous a figure if current rates of soil formation are considered (Dr. R.Evans, pers. comm.).

Costs are also incurred by local councils when eroded material has to be cleared from roads. During 1982-83 sand was cleared from the road between Little Burgate Farm and Marepond Farm.

Any consideration of the factors responsible for erosion at this site has to be tentative: in particular the influence of rainfall is difficult to assess since the date of erosion can only be assumed to be the autumn of 1982. However, with that important reservation, the chief factors responsible for erosion would seem to be:

1. cultivation of high-angle, convex slopes;
2. particle size characteristics of Frilford association soils make them prone to erosion;
3. relative wettness of the autumn of 1982, together with the presence of winter cereals providing little crop cover for the soil;
4. the ease with which water passed from field to field via tracks and gates allowed large amounts of water to reach valley-side slopes in field A.

Small-scale erosion of cultivated land on Frilford association soils is an inevitable consequence of excessive rainfall. However, simple measures could be taken to minimise erosion. Improvement of field boundaries would prevent water flow from field C to B and from B to A. Winter cereals on high-angle slopes in field A would seem to be an unjustified risk in most years.

8. ACKNOWLEDGEMENTS

Geological boundaries on Figure 1 are based, by permission of the Director, on Institute of Geological Science Sheet SU93NE. Mr S. J. Fordham, Soil Survey of England and Wales, kindly supplied information on soils in the area and the erosion of Little Burgate Farm was brought to my notice by Mr. I. M. Fenwick, University of Reading. Mr. S. Frampton drew Figure 1.

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A CRACK IN OLD VESUVIUS?

The dormant volcano Vesuvius is injured and could erupt, according to Professor Giancarlo Villardi of the Vulcanology Centre at the University of Catania, Sicily. 'The recent earthquake', he says, 'gave it a terrific jolt and cracked the hard crust, under the cone, which holds the lava under control.' (Quote from Daily Express).

TERTIARY AND QUATERNARY DEPOSITS AT V. F. ENGINEERING, ALTON

Cyril Potton and Lothar Neubert

Recent detailed geological research has largely by-passed the town of Alton in Hampshire. Two Society Members, however, have been working in the area and their efforts over the last two years are now presented.

1. INTRODUCTION

The following extract is taken from an as yet uncompleted report on a field survey being undertaken by the authors on various sites in Alton. Work on the survey has been going on for the past two years, the ultimate aim being to link the geology of Alton with the works of Dines & Edmunds (1929) on Aldershot and Guildford and Gilbert White (1788) on Selborne. The survey is completely independent of any organisation or professional body and is entirely financed by the authors. Requests for information and translations of practical and theoretical problems from individuals have been answered with a great deal of enthusiasm, and to these people we are greatly indebted.

The complete report will eventually consist of two parts. Part One is to deal with sites exposed along the valley of the River Wey, including possible old river courses, river banks and floodplains. Part Two will consist of sites that cover the area surrounding Alton. These will be mainly Chalk sites, so both pre-glacial and post-glacial deposits will eventually be surveyed.

2. CONTENTS

The contents of the extract plus drawings are the author's original interpretation and are subject to copyright. If, however, one of the interpretations has been previously published, then copyright will be withdrawn. The extract deals with an exposure which the authors cleared at V. F. Engineering. We hope that our explanations, in conjunction with the drawings, will be clear to the reader. If any mistake is noticed or some explanation is not clear we hope that it will be brought to our attention. The contents of the strata and an explanation as to how it was deposited is given in the text. To us, it is quite a unique exposure.

3. V. F. ENGINEERING

As both authors work at V. F. Engineering, access to the site presented no difficulty and we are extremely grateful to the Management and Workforce who extended their co-operation and interest to us. As V. F. Engineering is a private company, it is

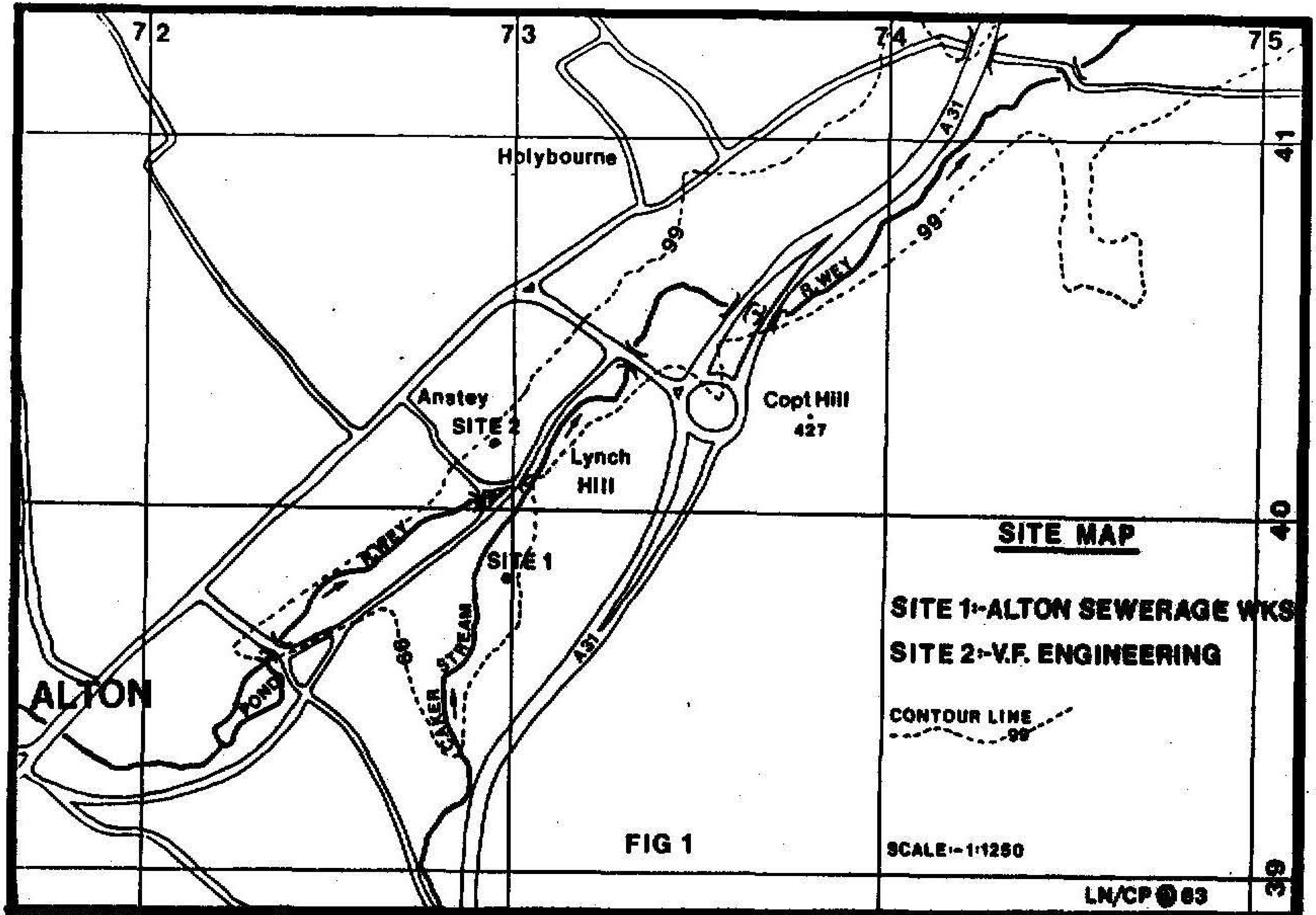
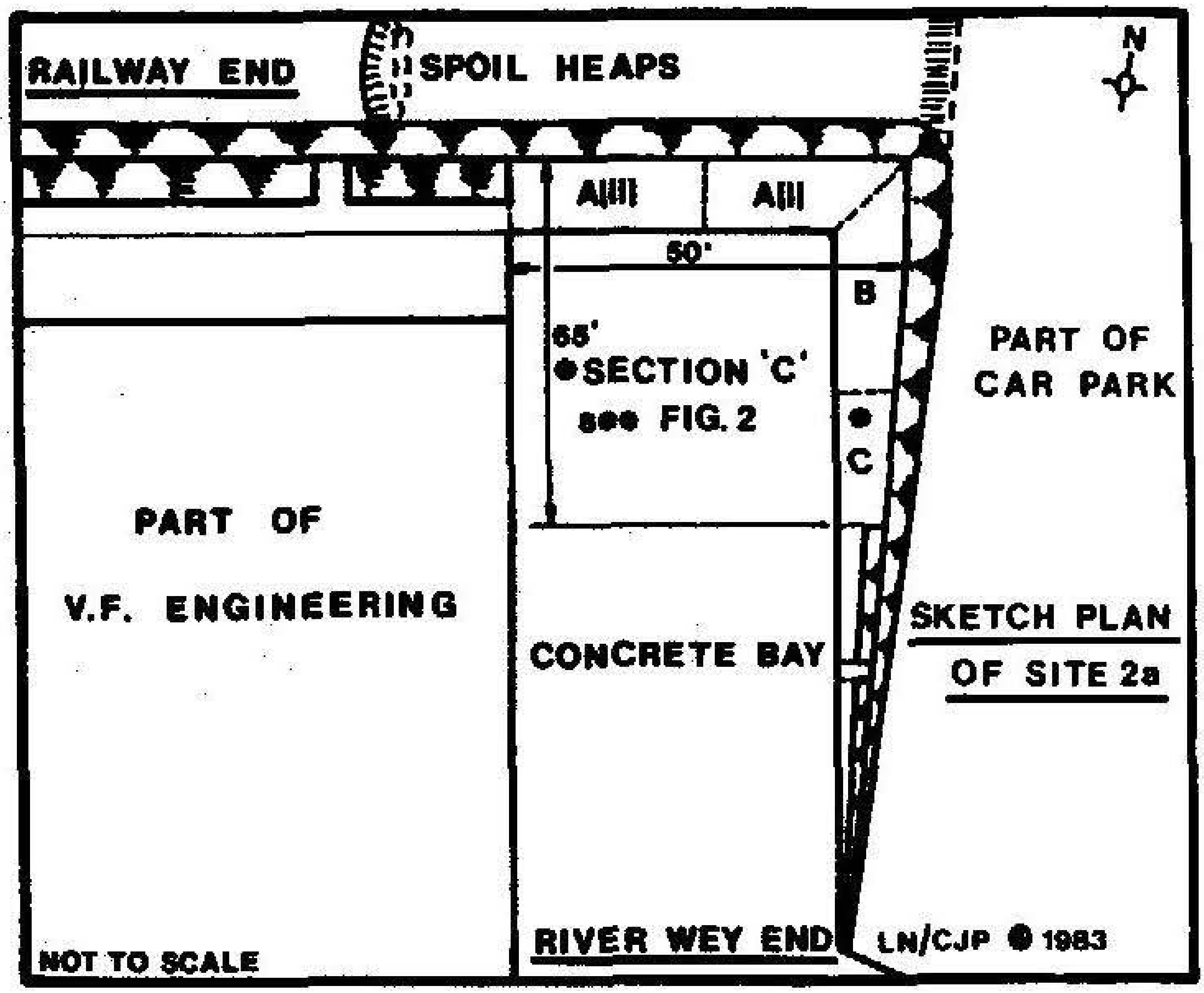

7 2
7 3
7 4
7 5
41
40
39
Holybourne
Anstey
SITE 2
Lynch
Hill
Copt Hill
427
SITE 1
ALTON
POND
R.WEY
A31
99
STREAM
CAKER
SITE MAP
SITE 1:-ALTON SEWERAGE WKS
SITE 2:-V.F. ENGINEERING
CONTOUR LINE
SCALE:-1:1250
LN/CP © 83

FIG 1

regretted that individual visits are not allowed, but if enough interest is generated, it is hoped that, at a later date, a group visit could be arranged. By then it is hoped that our excavations and documentation will be completed.



4. EXTRACT FROM TEXT

The description of these deposits is written in conjunction with Figure 2. Although the deposits were not stratified, they were arranged in three layers distinguishable by material content. The layers curved from bottom left to top right at roughly ten degrees, the Tertiary deposits being exposed in a shallow depression with an overall depth of three metres. The base of the depression ran parallel to the concrete in a south-easterly direction towards the River Wey and terminated where the slope met the concrete road. From this point onwards it could not be traced as it was destroyed during the construction of the factory. Gravel was reported to be underneath the concrete at a temporary exposure.

As can be seen from Figure 2, the relationships between the various deposits of this section were extremely complex. A possible explanation for the way this exposure developed is given below. In Phase One, which occurred during the late Palaeocene, Reading Beds clays were deposited on eroded fissured Chalk, the clays infilling the fissures. In Phase Two which occurred in the early Pleistocene the clays and the upper layers of the Chalk were affected by periglacial freeze-thaw conditions. This resulted in a churning up of the Chalk and clays in and around the fissures which extended laterally. The fissures now became solution pipes and the Chalk and clay below the zone of freeze-thaw remained unaffected.

This hard layer passed upwards abruptly into small jointed blocks of about five centimetres in overall size. This layer was also horizontal except at the railway end, where it curved upwards to join a layer in the adjacent exposure. Although a continuation of the adjacent layer, the layer at this exposure did not show the same type of structure. From the railway end to the second of the prominent solution pipes the strata above the block chalk was a crushed powdery chalk. This continued on below the Tertiary deposits where it became intercalated with several horizontal bands of pelleted chalk. Some derived fossils from the Middle Chalk were found and also various flint fossils from the Upper Chalk.

(a) TERTIARY INFILL

In order to make the description easier, reference will be made to the solution pipes at the base of the depression as numbers 1 - 7. Number 1 is the large solution pipe at the railway end with the large flint at its base.

At the bottom of solution pipes 5 and 7 was a layer of brown mottled grey stiff clay. This clay was also present as a band across solution pipes 2, 3 and 4. Two bands of this clay were also found in pipe 6 and were separated by two bands of gravelly brown clay. The clays mentioned are at the bottom of the fissures. In Phase Three, at the end of the Pleistocene, the freeze-thaw zone and part of the previous unaffected area were subject to a later episode of freeze-thaw, producing the effect seen in Figure 2.

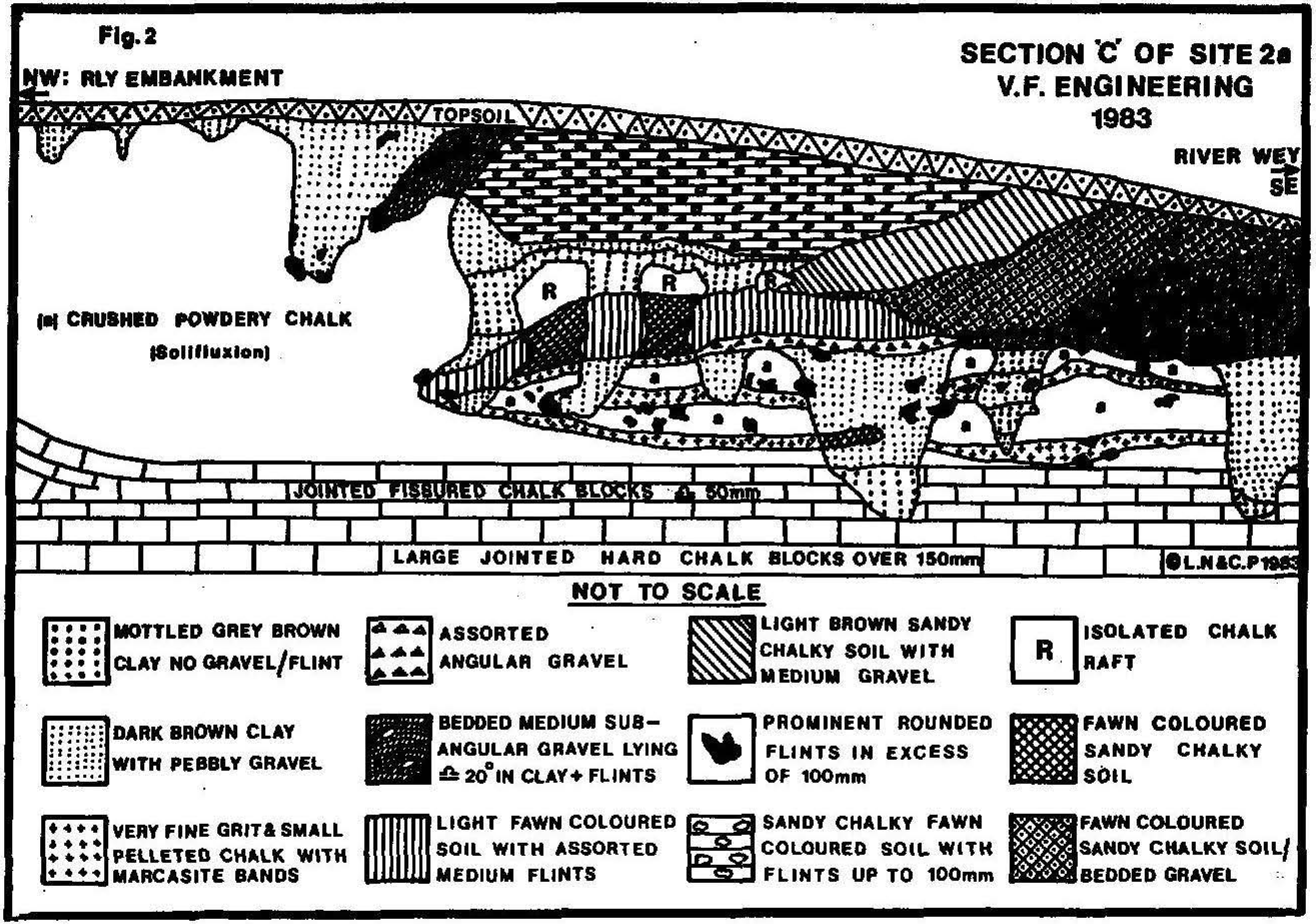
The Cretaceous/Tertiary boundary was clearly visible and very distinct and at first glance the exposure tended to suggest several infill pipes which were similar but smaller than those found at Froyle Quarry (Carolan et al 1981). The pipes which were infilled fissures were, in fact, part of a large shallow depression with Tertiary infill and reworked solifluxion. The basic contents of the exposure showed clay, sandy soil and solifluxion material with various combinations of gravels and flints.

Owing to the complicated nature of this section it is recommended that the reader refers to Figure 2 while reading the description.

(b) CHALK

The Chalk at the base of this exposure consisted of large jointed hard blocks, which formed the base of the complete length of this section. From the fossils found the Chalk was identified as Middle Cenomanian (Rhotomagense Zone). The Chalk was bedded horizontally with a possible dip of about three degrees north-east.

Above the top marcasite/iron pyrite band and the bedded gravel, the material became more sandy, but still contained some small to medium flints and gravels. From pipe 2 through to pipe 5, the soil acquired a fawn colour and was of a sandy texture. Although


SECTION 'C' OF SITE 2a
V.F. ENGINEERING
1983
NW: RLY EMBANKMENT
RIVER WEY
SE
TOPSOIL
R
(s) CRUSHED POWDERY CHALK
(Solifluxion)
JOINTED FISSURED CHALK BLOCKS ≙ 50mm
LARGE JOINTED HARD CHALK BLOCKS OVER 150mm
©L.N&C.P1983
NOT TO SCALE
MOTTLED GREY BROWN CLAY NO GRAVEL/FLINT
ASSORTED ANGULAR GRAVEL
LIGHT BROWN SANDY CHALKY SOIL WITH MEDIUM GRAVEL
ISOLATED CHALK RAFT
DARK BROWN CLAY WITH PEBBLY GRAVEL
BEDDED MEDIUM SUB-ANGULAR GRAVEL LYING ≙ 20° IN CLAY + FLINTS
PROMINENT ROUNDED FLINTS IN EXCESS OF 100mm
FAWN COLOURED SANDY CHALKY SOIL
VERY FINE GRIT & SMALL PELLETED CHALK WITH MARCASITE BANDS
LIGHT FAWN COLOURED SOIL WITH ASSORTED MEDIUM FLINTS
SANDY CHALKY FAWN COLOURED SOIL WITH FLINTS UP TO 100mm
FAWN COLOURED SANDY CHALKY SOIL/ BEDDED GRAVEL
Fig. 2

the layer was continuous where it passed through the powdery chalk, it contained no medium sized gravel as this type of sediment only occurs within the sandy material in the pipes themselves. The sandy material continued in a gentle curve to the top of the exposure.

At pipes 2, 3 and 4 above the soil and flints a layer of mottled grey-brown clay occurred. This was the same as the clay at the base of the pipe, while above this was brown clay with small flints. In between pipes 2, 3 and 4 two isolated chalk rafts occurred at this level, together with another slightly to the right of these. This layer of clay became a light brown sandy soil with medium gravel towards the River Wey end. The topmost infill in this exposure consisted of a sandy chalky fawn soil containing an assortment of flints and gravels. These were unbedded and generally unsorted. However, it is possible that these were deposited by the River Wey at a later stage as they are generally water worn. To the right of pipe number 1 was a patch of bedded medium sub-angular gravel which was very similar to the gravel above pipes 6 and 7. These two areas of gravel showed definite current orientation in a north-south direction. The bulk of the material found in the pipes consisted of a dark brown clay with pebbly gravel. Only three pipes, namely 1, 6 and 7, contained a clay material without alteration. It was interesting to note that all the pipes contained a clay material, the clay completely filling the pipes. The clay was thickest at the railway end of the exposure. In five of these pipes the clay was separated by bands of sandy soil. Above numbers 6 and 7 was a large area of bedded sub-angular, and part rounded gravel in clay, the gravel being thickest at the River Wey end. Above the gravel at this end, the clay passed into a fawn coloured sandy gravel which was still bedded by not so pronounced as below. The sub-angular gravel in clay narrowed considerably in the direction of the railway to form a thin band above pipe 6 and continued through pipes 5 and 4 as a band of assorted angular gravel. From pipe 4 it continued onto pipes 1 and 2 but was split by pipe 3. This part of the band consisted of very fine chalk pellets and small flint pieces along with minute pieces of marcasite/iron pyrite. The marcasite/iron pyrite formed horizontal layers which could almost be called bedded layers and it also formed localised pockets. This band and the bottom of the gravel area formed the edge of the gravel material between the clays in the solution pipes and the sandy material above. Two more bands of the pelleted chalk and grit occurred in the crushed powdery chalk below the infill. These bands did not pass through the pipes but stopped and re-appeared on the other side of each pipe.

(c) FLINTS & MARCASITE/IRON PYRITES

Most of the prominent flints occurred in the area of the solution pipes and the powdery chalk. There were no prominent flints in the gravel material. An interesting aspect of this exposure was the abundance of weathered marcasite/iron pyrites which was present in all parts of the exposure being more concentrated in some parts than others. The sizes were variable with some of the small pellet-like pieces being arranged into layers in the lower part of the exposure as well as being scattered. The marcasite/iron pyrite in the infill part of the exposure was broken and weathered, its colour being dark brown or black. The specimens found in the hard chalk were a bright orange or rusty colour and were always surrounded by a sandy chalk which was very crumbly even when wet.

(d) POINTS OF INTEREST

Work on this exposure began in March 1983 and was completed in July 1983. Although this exposure is complete, work is still in progress on the rest of the site. All work is done at weekends with the occasional tea-break being given up to help speed the work along. On this exposure alone some 115 tons of material has been removed. This was shifted by means of pick-axe, spade and dumper truck and took a total of 152 hours. The total material excavated and moved from the whole site will be in excess of 250 tons. The first two sites which comprise Part One of the survey will be completed and a small booklet will probably be available in the not too distant future.

5. ACKNOWLEDGEMENTS

The authors would like to express their appreciation to Mr T. Macleod-Clarke, Managing Director of V. F. Engineering, for all his encouragement during the preparation of this study. Further thanks are also due to Mr B. Adams (Works Director), Mr G. Crow, and Mr R. Pink, all of V. F. Engineering, for their continued assistance in the project. A special thanks is also due to Beryl, Maureen and Sue in the Works Office, without whom the transcript would never have surfaced.

Dr. E. F. Owen of the British Museum (Natural History) has also been a source of constant encouragement and enthusiasm. His palaeontological identifications have been of tremendous help to both authors.

For on-site assistance, the authors would like to thank Society Members Dr. P. A. Olver, and Daphne and Clifford Tarbox, whose general help with the geological problems encountered has been greatly appreciated.

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GEOLOGIZING IN SOUTH DEVON

Marybeth Hovenden & Elizabeth Matthews

A light-hearted look by a Society Member at a typical weekend "on the rocks".

In early March of the recent era of the Quaternary period, forty-four of the genus Homo sapiens who had the inclination to transgress to Torquay, twinned up at Farnham Station for transport by coach to South Devon, the subject - a weekend geologizing. Chisels, hammers, helmets, hampers and walking sticks were quickly thrust into the vesicle, while other agglomerates were deposited inside, albite disrupting the coach's synclinal axis. Too late now to remember balaclava, calamine or tufa, we were off into the rugose sunset.

Soon it was necessary for those whose porosity was apparent to stop at a filling station. After flexing adductor muscles, we were quiescent until deposition at The Hunters' Moon Hotel, where we found bar and crust awaiting. Then we were shown to our magma chambers, some to find competent beds and even basins, but in general all the matrices were glacial.

Our first day was one of condensed sequence. Hay Tor for most of us was to be the high spot of the day. It was elemental here to grasp the granite sequence. Serious students were looking at the horizontal jointing (Figure 1) and pondering how Carlsbad twinning had occurred. They marbled at this high example of Hercynian orogeny and at the pneumatolytic process of tourmalinisation that had been caused by boron and fluorine gases eating into the granite at the end of its crystallization. For those who weren't schorl, terms like 'megacrystic' and 'solifluction' were explained. The temperature here confirmed our suspicion that we were no longer in the sandy Sahara-like position 25 degrees North of late Carboniferous times. Many photos were taken of the Bovey Tracey Basin, source of china clay and kaolin for the pottery industry, and samples of erratic material that clittered the slopes were collected.

We next entered Bullycleaves Quarry, where a series of dark grey limestone laid down in a back reef environment have for centuries provided building stone for such edifices as Buckfast Abbey. Promise of corals, stromatoporoids and umber had some of us paralic with excitement, while the more mature amongst us were eagerly discovering dykes, unconformities and thrust planes.

Then a lunch stop at the Dartbridge Arms, where we downed iron-stained quartz and hammers to take on fossil fuel. With all soon saturated we came upon a Lithostrotion junceum, and made off for an argillaceous afternoon on Goodrington Sands. This was a fossil desert environment, where angular rock fragments had been denuded by flash flooding into a Permo-Triassic basin. These deposits now lie with a strong unconformity on dipping Lower Devonian purple slates. Burrows and pipes at Waterside Cove made by unknown organisms or agents gave rise to littoral suggestions of their possible nature which exposed our supratenuous gravity! Our serious student exchanged boudinage with his friend about the Z-folds while locating in the reddish crystallized calcite a fine specimen of dog-tooth spar.

That evening it was the composite opinion, after a trilobite, that the day had been an uplifting one, and banded by shared cleavage we went to our conchoidal beds.

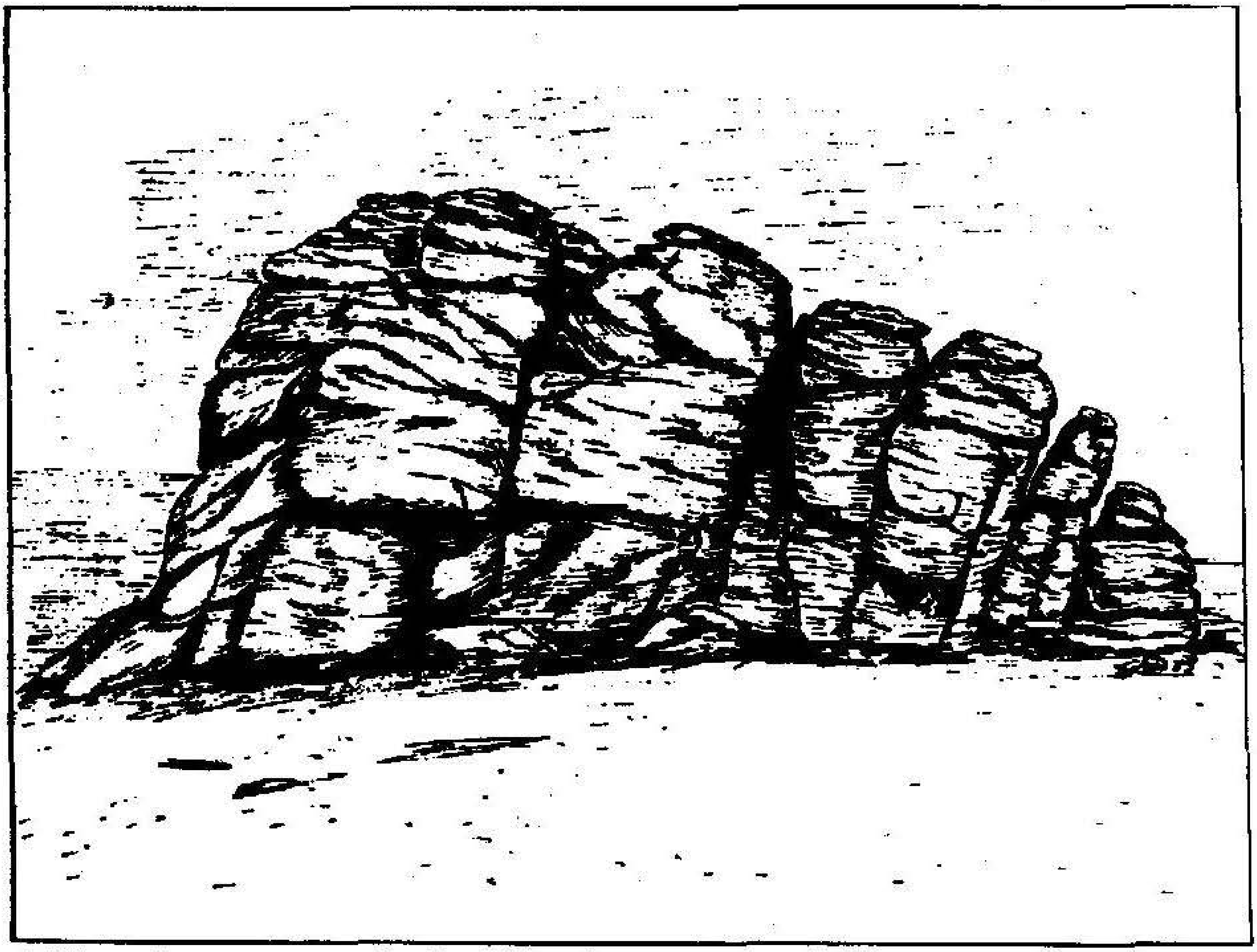


FIGURE 1: Haytor Rocks looking west (SX 759771) - a classic Dartmoor tor showing well developed near-vertical cooling joints and subsidiary horizontal pressure release planes.

Sketch by Charles Ives

On Sunday, warm convection currents made us rhyolite early, and after a Rhaetic series of starts, we declined into Kent's Cavern, the habitat of Early Man. With hardpan faces we injested the data about stalagmites and stalactites, hyenas, hunters, harpoons and dates varying erratically between twenty and two hundred and twenty million years. But it was flinty gravels we were after, so we next made the gradient to the Haldon Hills above Exeter. Soon this Blackdown facies was alive with the sound of hammers. Those who exposed Exogyra, Trigonia, and Venericardia can be very proud of these. When our entropy was exhausted, we refuelled at an overthrust slope above Exeter, with fine views, then the drift was towards Dunchideock Quarry, were we conjugated with zeolite and calcite vesicles in lava. The way-up criteria here for some was *a problem, but the affluent amongst us collected basic* olivine-rich basalt and other fine specimens of the Exeter Volcanic Series.

Now to Seaton, where walking along the pebbly beach our wit noted that the rocks underfoot sounded "like a horse eating celery", an indication that he was not seriously geological. Above him, the chocolate-coloured marls, and beyond these, the last Chalk cliffs in a westerly sequence in England, were demanding attention. Romantics amongst us were gravelling in the apt names of Beerstone, Cowstone, and Foxmould we were searching for.

Now it was time to depart. Some were growing crumpled and inarticulate, and all were several stones heavier. So rejuvenated by such a magnetic excursion, and enriched by the syntaxis of this exogenetic experience, may we simply thank our leader, Dr. Olver, who is in no way responsible for any incongruities in the text!

GEOPOETRY

Michael J Phillips

THE DESERT

I wonder why the desert draws me so,
It cannot be a softness to the Soul.
The stark land-climb and harsh reality
As plants and flowers parched grow.
The pared feeling everywhere that
There cannot be green fields anywhere.
But as I stand and feel
The sun's full radiant rays intensity,
And the bare rocks echo back the Solar Winds
In jutting reds and yellow-brown complexity -
Somewhere in England
A patch of green breathes soft tang of
Pine Woods that stretch for ever;
Rivers feeding Trout -
Makes me in the desert-blast cry out!

ROWHILL NATURE RESERVE - ITS GEOLOGY AND SOILS

Paul Lund

This short introduction to the Rowhill Nature Reserve by a local amateur geologist highlights some of the interesting and less studied Tertiary deposits on Farnham's doorstep.

Pinecroft, Rowhills, Heath End, Farnham, Surrey

Rowhill Nature Reserve is located between Farnham and Aldershot, near Heath End, on the County boundary to the west of Surrey. The land within the boundary comprising the Reserve covers approximately 50 acres and lies on an east-west axis (Figure 1).

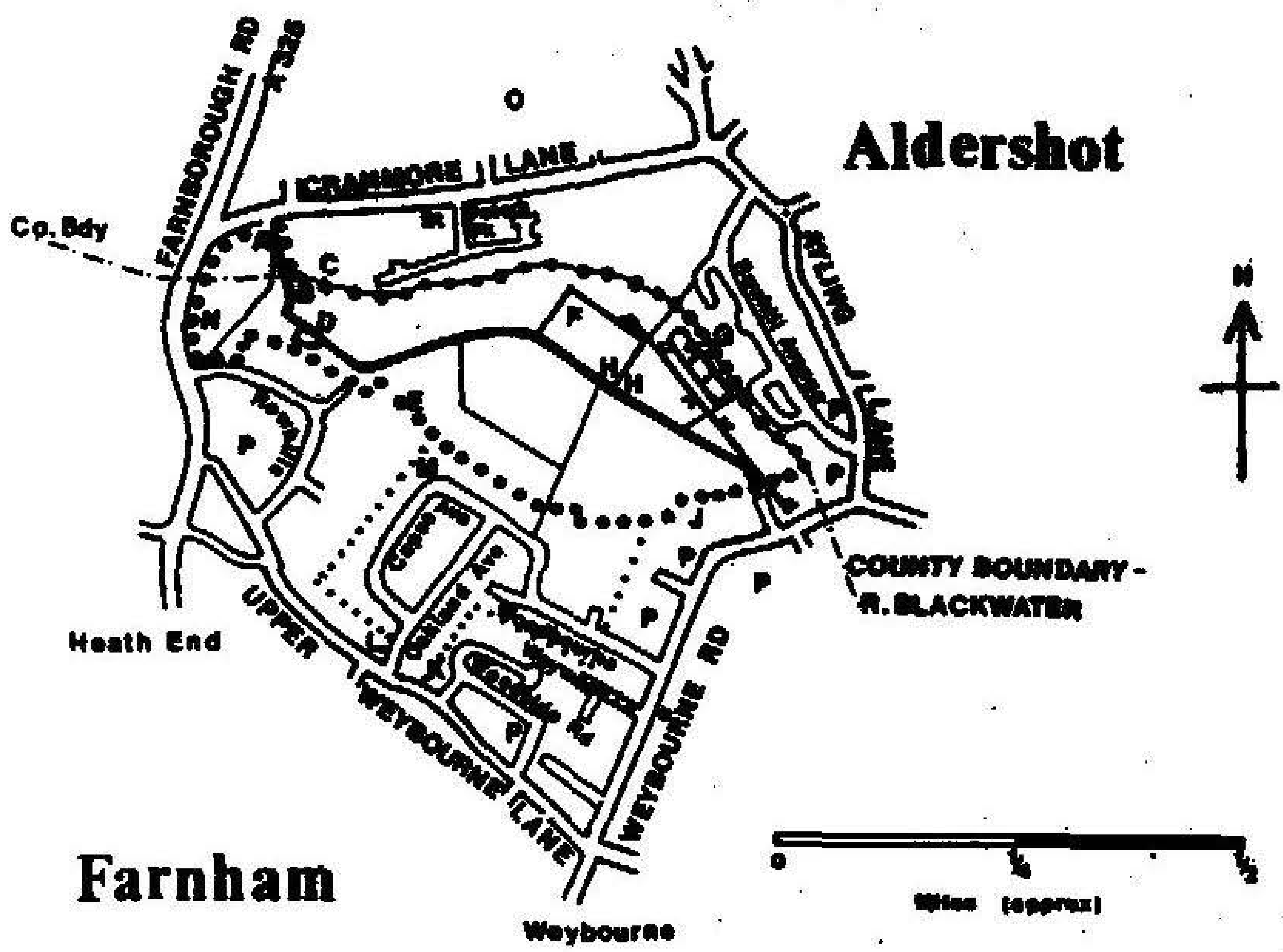
The rock material forming the area is of sedimentary deposits laid down during the Eocene Epoch, about 55 million years ago, in the Tertiary Period. During the early Tertiary, a large river delta lay across the Aldershot area. To the north, beyond the delta's edge, fully marine sediments were deposited in areas from Weybridge across to North Kent. Behind the deltas, the erosion of the Chalk landscape continued with dense tropical forests mantling the raw limestone slopes. Rowhill Reserve stands at the Tertiary interface between deltaic and marine conditions and shows evidence of several transgressions and regressions. The three main rock types in the Reserve are Bagshot and Bracklesham Sands to the west on Hallimore Hill and London Clay on the lower eastern slopes. The source of the River Blackwater rises in the Reserve and before river capture by the Wey took place, it had deposited much alluvium, part of which is found along the north-eastern boundary.

The western side of Hallimore Hill in the Reserve is covered in heath and scrub vegetation with birch and pine being the main dominant trees. This vegetive cover is typical of the local sand based soil. The low vegetive cover and porosity of the sand have resulted in little of the plant nutrients and humus being retained, leading to leaching and deposition at lower levels, producing the typical podsol.

This soil type and the Bagshot Sand can be seen on the exposure near the Farnborough road (SU 8480 4984). Here the sand has been progressively eroded down onto the road causing a wide deep gully to form on the hillside.

The slope is covered in flint pebbles and loose sand. Much of the pebble material is small in size being about 5 cm wide and ranging up to 150 cm. Along the length of the gully the pebbles are mostly angular in shape and within the still consolidated bed appear in thin sand intermixed layers. Within this material various specimens were found with hollow centres filled with small quartz crystals.

ROWHILL



A	Field Centre & car park
B	Blackwater source / Hollowe More
C	Rough Coppice
D	Stickleback Pond
E	Sand/gravel pits
F	Field
G	Kingfisher Pond
H	Brickworks (site of)
J	Donkey Orchard / Old Foxes
K	Little Loose Hills
L	Boundary Oak
M	Copse House (site of)
N	Hallimore Hill
O	*Cranemore*
P	Hopfields
● ● ● ● ● ●	Extent of RESERVE
• • • • • • •	Extent of Copse c1959
━━━━	Main path in RESERVE
────	Other paths
─x─x─	*Overhead electricity lines*

FIGURE 1: Locality map showing the main features of the Rowhill Nature Reserve.

The Bagshot Sand appears as bright red-orange tinted material at the top of the exposure with small collections or seams of a lighter, finer grained sand. At the base of the exposure the sand is bright yellow with dark iron streaks.

Samples of these two sands were taken for sieving to find out any possible difference in size and quantity of sand grains. The results are shown as bar graphs in Figure 2. Each sand sample was sieved in a similar direction for 15 minutes and the resulting graded samples weighed. Sand from the second sample (No. 2) at the 80 number sieve size was observed under a binocular microscope and appeared as mostly quartz fragments, very angular in shape, indicative of transportation by river. The water surround acts as a cushioning effect preventing abrasion and rounding.

Two samples of sand were taken on the south-western side of the exposure. Here there had recently been a fire to burn some dead vegetation resulting in a thin layer of sand being heated. This layer had turned to a brick-red colour. The samples, one of this red sand and one of the unaffected yellow sand a few centimetres beneath were used in an experiment to investigate the effect of heating iron compounds. The yellow sand sample was put in a crucible and heated with a bunsen burner. Within ten minutes the sand had turned the same red colour as the red sample sand, indicating the colour was due to a rapid oxidation of the iron in the sand.

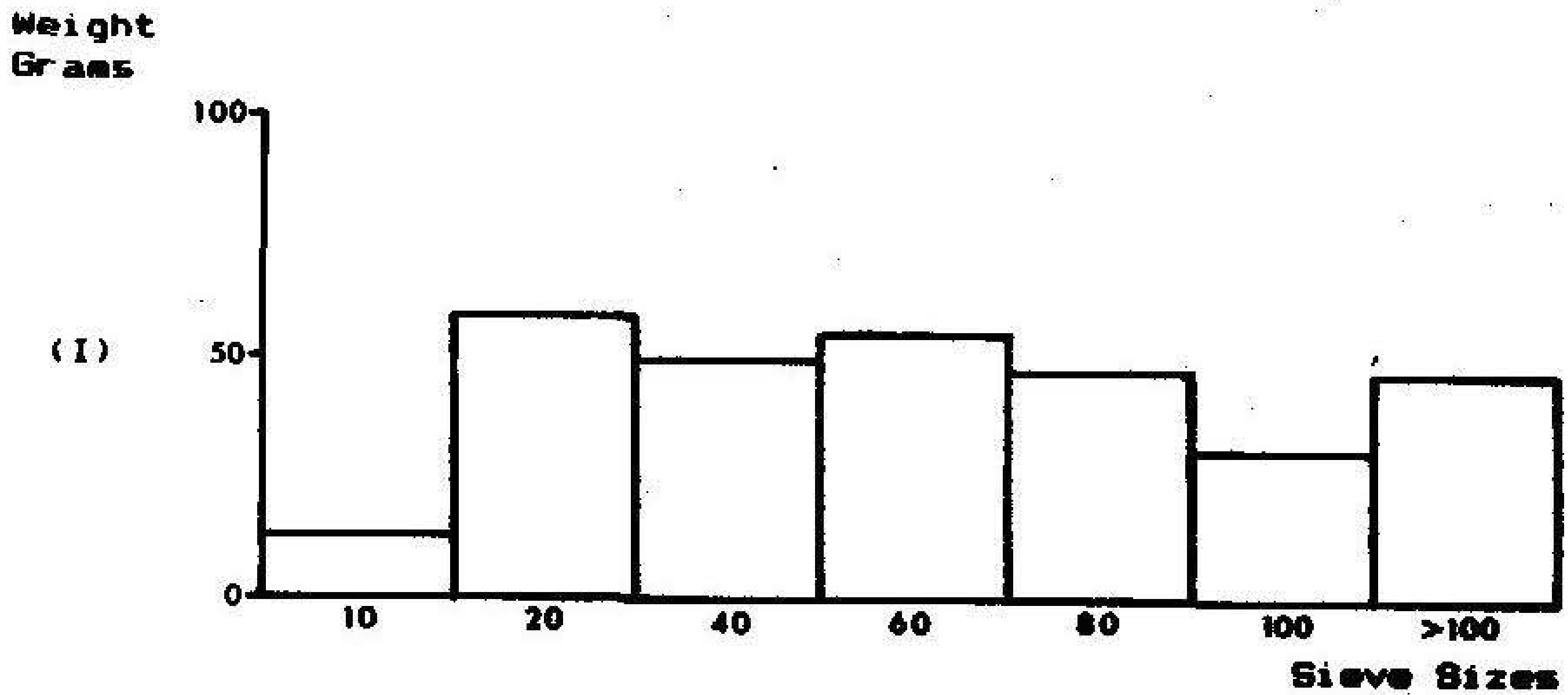
At the south-eastern corner of the exposure gorse roots penetrating the Bagshot Sand have produced the beginnings of root marks. The growing roots pushing through the sand have displaced sand grains leaving larger pore spaces which have been infilled by rain water percolating down and depositing finer material, which is of a lighter colour. Amongst the flint material there are flint pebbles that have been cemented together by iron rich sand material forming conglomerates.

On the eastern side of the hill mature pine trees have shaded out the ground cover vegetation allowing the slope of the ground to be seen clearly. In this area outcrops the Bracklesham sand. Using the soil auger, samples brought up were dark in colour down to 0.7 m with little indication of any change or distinction between the sands.

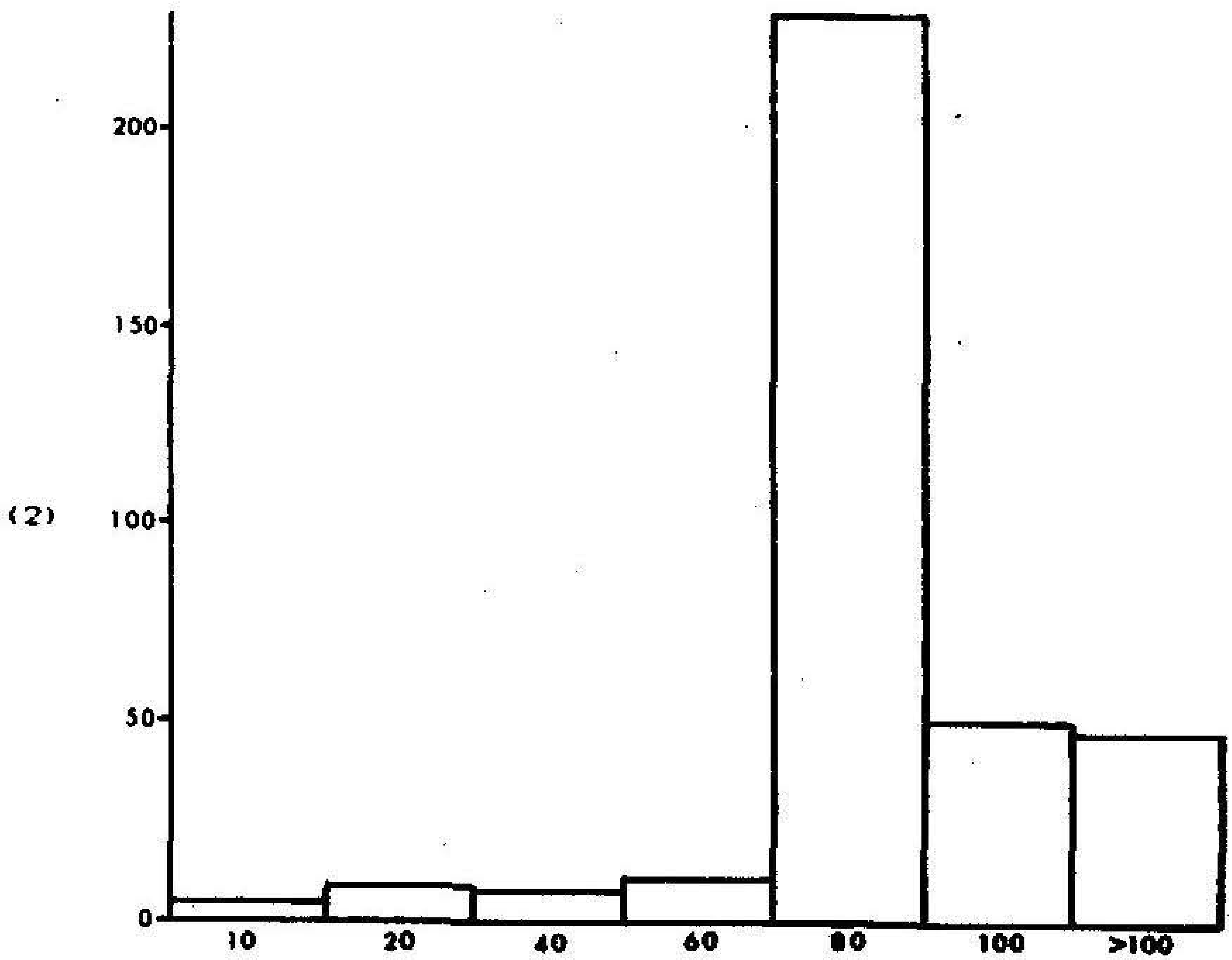
Following the path down the hill eastwards towards the foot of the scarp, a distinct change from coniferous to deciduous trees is seen. This is due to a change in drainage and soil type. At the base of the hill a stream forms from the draining of a ditch running parallel to the base of the hill. This is the source of the River Blackwater. Within an eroded depression a small deep peat bog characterised by sphagnum moss has formed around the stream. Clay underlies this area covered by a thin eroded deposit of Bagshot Sand that extends to the small pond.

SIEVE ANALYSIS

BAGSHOT SAND SAMPLES



Specimen I shows a random sorting not showing any particular sorting into one grain size.



Sample 2 - well sorted into the 80 size sieve indicating greater degree of transportation and sorting.

FIGURE 2: Histogram analysis of two samples of Bagshot Sand drawn from Hallimore Hill, western edge of Rowhill Nature Reserve.

Hallimore Hill in the west slopes round and encloses the land to the south of the pond giving protection to the pond and surrounding vegetation. Using the soil auger, samples were taken around the clay/sand junction. The cores revealed intermixing of sand and clay. Along the length of the path, past the pond, drainage is bad resulting in mud coverings. About 100 m from the pond the clay is visible on the path and where a chestnut tree was blown over, the clay can be seen beneath a layer of humus.

At the western end of the four-acre grass field the clay can be seen to a fuller extent. A sample was taken here and washed through a series of sieves, resulting in the clay being washed out leaving only a few sand grains and small amounts of vegetive matter on each sieve. During the dry weather the clay here has dried to a depth of one centimetre resulting in the formation of mud cracks.

Further down the slope, past the field, a thin seam of chalk can be seen in the bank of a stream crossing the path. This must have resulted from a pile being tipped for use on what was then the brickfield area. Much of the lower end of the Reserve was used for excavating the London Clay for making bricks. These bricks can be seen in old buildings in Aldershot and old weirs in the Reserve. The lower Kingfisher Pond (see Figure 1) is a result of such an excavation. To supply the pond the River Blackwater was diverted and within its banks layers of recent alluvium can clearly be seen. The alluvium looks much like the surrounding clay, but on examination it is drier and more friable.

At the end of the Reserve the land is gently sloping. A thick grass growth covers most of the ground under the trees in this area, indicating fertile alluvial soil. The Blackwater shows some natural meanders but is mainly controlled by the boundary route it takes. The characteristic deposition and undercutting of the river can be seen in and around the meanders.

In conclusion, the Rowhill Nature Reserve owes its variety of bedrock to the trangressions and regressions of Tertiary seas. Later periglacial effects, such as solifluction flow, and the constantly changing course of the River Blackwater have combined to modify these bedrocks and produce Rowhill's present landscape.

ANSWERS TO GEOLOGICAL CROSSWORD (July 1982)

Clues Across: 1. Monoclinic 6. O.R.S. 9. Ludlow 10. Algae 14. Lava 15. Sn 17. Stipe 20. Er 21. Test 23. Iron 25. Slit 26. Acid 29. Neck 30. HgS 34. Slag 35. Unio 37. Gingko 38. Ice 40. Lias 41.Ra 43. Geode 45. Gryphea 46. As

Clues Down: 1. Millstone 2. Node 3. Cross 4. Io 5. Inlier 7. Ru 8. Galena 11. Ray 13. Si 16. Ne 18. Talc 19. Pith 22. Secondary 24. Ni 27. Calcite 28. Dog 31. Gangue 32. Bog 33. Zone 36. Flag 39. Eyes 41. Rh 42. Aa 43. Ga 44.Os

THE MINERALOGY OF THE TERTIARY DEPOSITS IN TWO TEMPORARY EXPOSURES IN THE ALDERSHOT AREA

D T Moore and L R Johnson
(Department of Mineralogy, British Museum (Natural History)
Cromwell Road, London SW7 5BD)

1. The Middle Bagshot Beds/Virginia Water Formation at Royal Pavilion roundabout (SU 852509)

During roadwork in 1980 on the Fleet road, close by the Royal Pavilion roundabout on the A325, a temporary exposure revealed part of the 'Bracklesham Beds' (of the Geological Survey), i.e. Middle Bagshot Beds of Prestwich (1847), and the contact with the underlying 'Bagshot Sands' or 'Virginia Water Formation' of King(1981,1982). Below the soil level were some 34 cm of more or less horizontal grey clays (Middle Bagshot Beds) overlying yellow sands with numerous ferruginous stained patches (Virginia Water Formation). The base of the latter was not seen.

Sieving showed the clay to be barren of microfossils larger than 150 um, although fish teeth are known from this horizon at Pirbright (Dines and Edmunds,1929). X-ray diffraction analysis revealed that the clay contains some goethite, quartz (approx. 28%) and some 50% clay minerals - mostly illite, with subsidiary amounts of kaolinite and chlorite.

2. The London Clay at the junction of Cranmore Lane and Cherryhill Grove (SU 855501)

During construction of a sewer in 1982 in connection with the Cranmore Park development, a temporary exposure of the yellow-grey weathered top of the London Clay was seen under about 90 cm of soil. The base of the Clay was not seen but it is known to be some 332 ft (99.6 m) thick in the Aldershot area (Dines and Edmunds,1929). X-ray diffraction showed the Clay to consist of about 27% quartz and 65% clay minerals, the rest being amorphous material. About half the clay fraction consisted of montmorillonite with decreasing amounts of illite, kaolinite and chlorite. As in the first case, the sample studied was found to be barren of microfossils larger than 150 um, but the impression of a bivalve was seen; marine bivalves are recorded in the Sheet Memoir as occurring in the Aldershot area (Dines and Edmunds,1929).

3. Acknowledgements

Thanks are due to Mr. J. Cooper of the Tertiary Research Group for helpful discussion.

4. References

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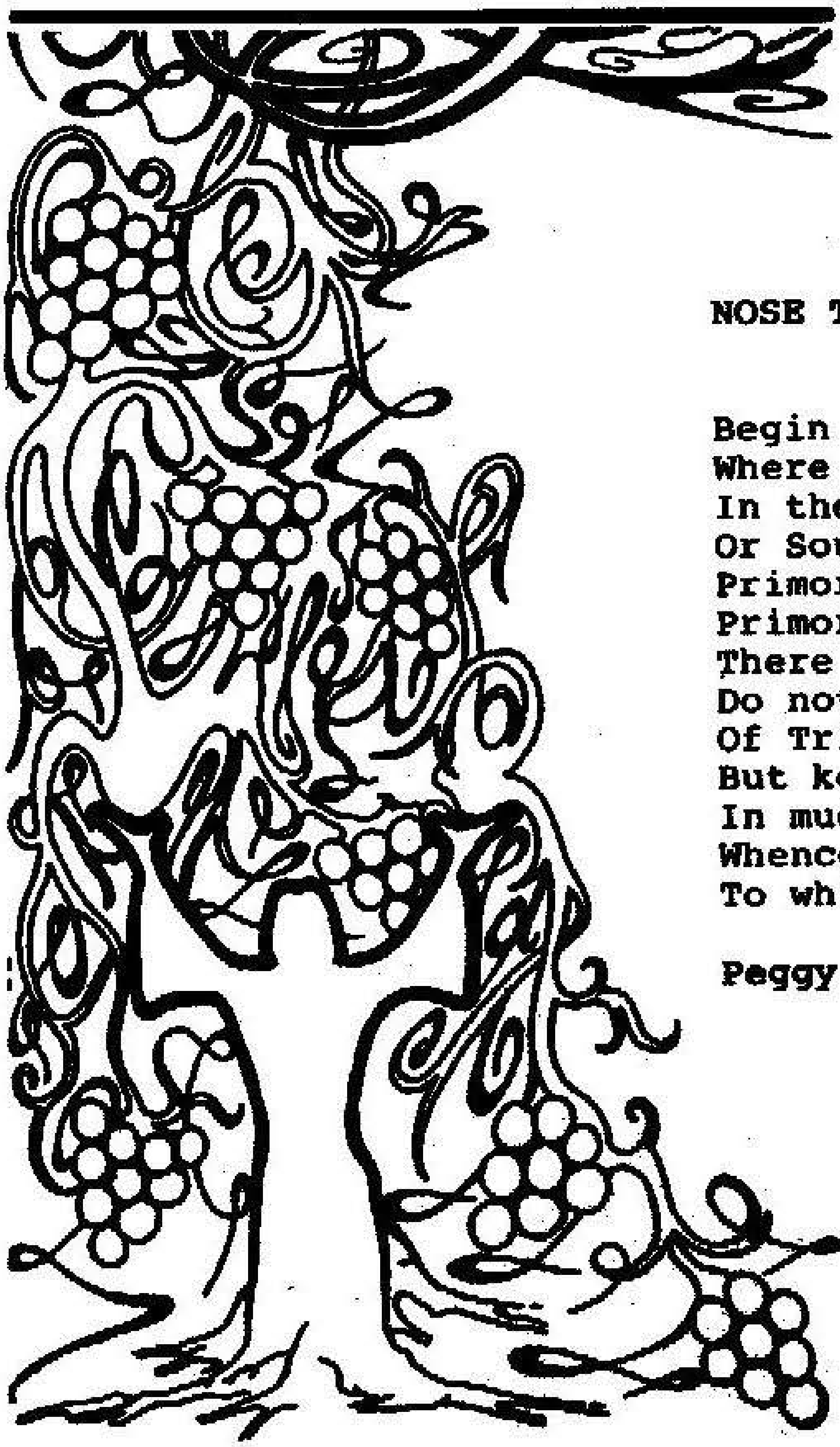
GEOPOETRY



NOSE TO THE GROUND

Begin at the beginning
Where you began.
In the beginning was mud,
Or Soup,
Primordial Soup
Primordial mud;
There you began.
Do not aspire to heights
Of Trilobites and Ammonites,
But keep your nose
In mud and pong
Whence you emerged;
To which you still belong.

Peggy Innes

GEOLOGICAL MAPPING IN SOUTHERN CANTABRIA, NORTHERN SPAIN

Graham Bourgoing

Individual geological mapping, a necessary part of any degree course, can present quite a challenge to any student. Graham Bourgoing outlines below some of the problems and the pleasures of life in North-West Spain.

During the summer of 1981 four of us from Imperial College mapped an area of about 100 sq km in the southern foothills of the Cantabrian Cordillera of Northern Spain (Fig.1), as part of our degree course in Geology.

Having set up camp in the small village of Cremenes on the main road from Leon to Oviedo and Santander, beside the River Esla, we drew straws for our respective 25 sq km areas. My area was in the south-east, with mountains of about 1800 m high, rising 1,000 m above the valley floor, with good exposure, especially on the higher slopes. There was an eight o'clock bus into the area every weekday morning.

This posed the first problem, how to pronounce the village names in my area in order to be put down at the correct place, and not carried as far as 100 km south to Leon for example. The local stratigraphy was the next problem as their formation names are totally different from British stratigraphy. The Cambrian System consisted of a limestone formation and part of a sandy shale formation, while the Devonian system consisted of limestone and shale formations without a red bed to be seen except in the underlying Silurian-Devonian boundary formation.

Working problems were mainly concerned with temperatures which varied from early morning when it was a crisp high altitude mountain temperature, until early afternoon when it was the Spain of the travel brochures. Usually I worked uphill until near midday, looking at exposures and marking them on the map when I had found which valley I was in and which way up the field map should be, not to mention making sure I had identified the rock formation correctly! I also had to keep in mind any problems which were thrown up by mapping the exposures, such as faults, small folds and changes in bed thickness, both tectonic and sedimentary, and whether they caused other changes elsewhere in the area.

During the afternoon I usually began my descent down the other side towards our camp which was in walking distance of the peaks in my area. On arrival back at camp I would usually flake out in the shade, go swimming in the Esla next to our tents and down three or four Cokes. Later on one would have to transfer all the information on the map into a coherent inked statement with symbols, and try to think logically about how to continue the work the following day. The other three and I usually discussed these problems with two Dutch geologists, who were camping nearby, in the bar over a bottle of wine waiting for dinner and the customary veal cutlet.

By the fourth week in the field my map was starting to transform itself from a drunk spider's attempt at art nouveau into a proto-geological map, with the addition of a little colour and a joining up of dots. The last days in the field were largely a matter of filling in small gaps, gathering fossils (mainly from the rich Devonian reefal faunas) and samples for later sectioning back in London as well as re-checking earlier mapped areas.

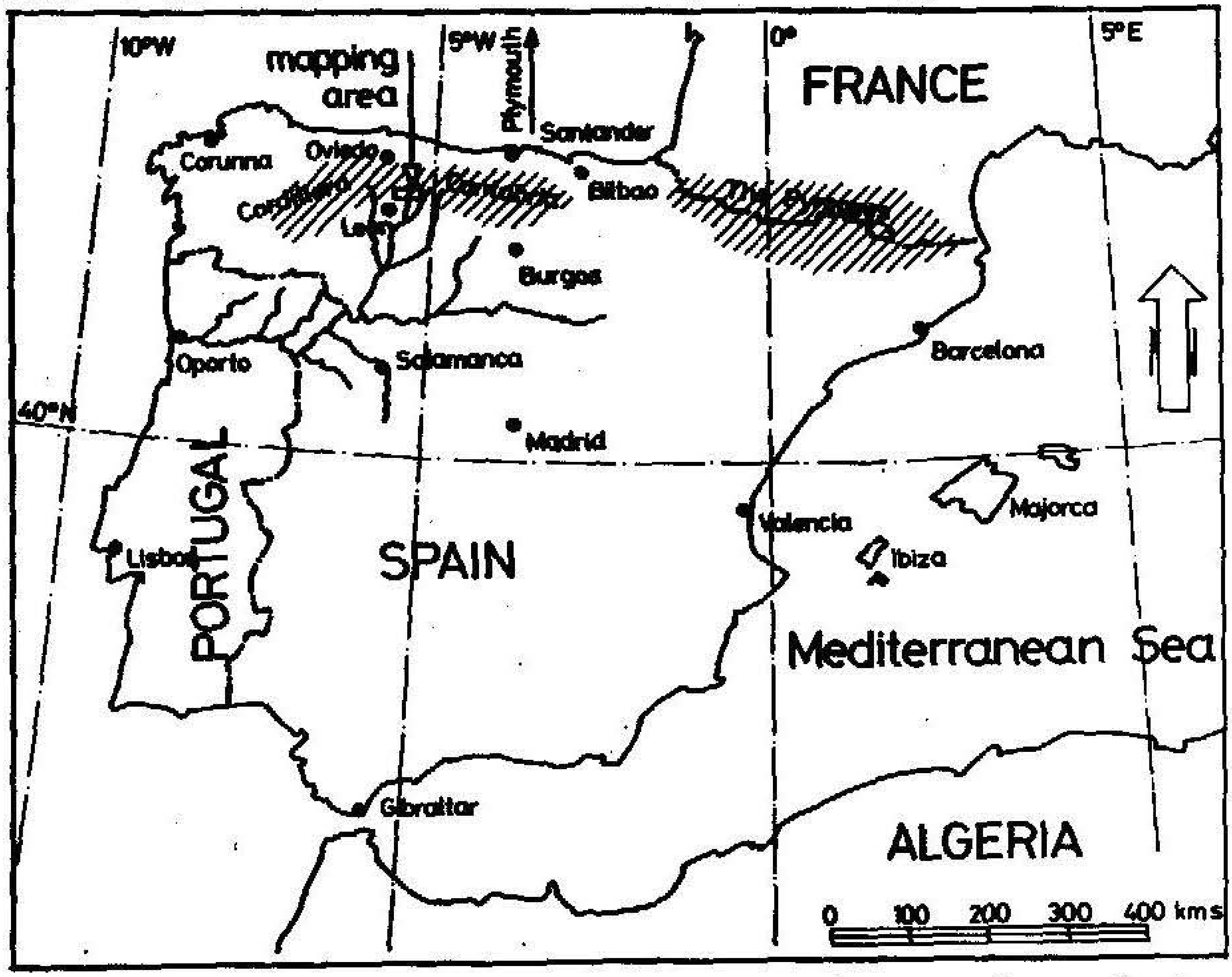
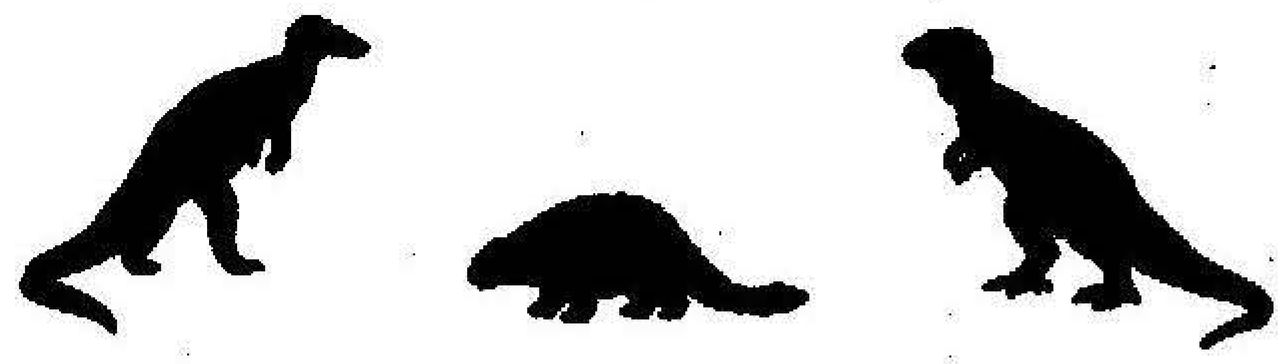


FIGURE 1: Locality map of Southern Cantabria, Northern Spain, showing field area covered during the mapping project.

During this period of time one of the Dutch geologists discovered plant remains in a proto-coal cyclothem in the San Pedro Formation which lies on the junction between the Silurian and Devonian systems and is a predominantly red bed formation. These Upper Silurian plant remains were rather an important discovery having only been reported in a few locations worldwide.

This type of discovery and the fun in producing a geological map with some scientific validity was very rewarding especially putting all four maps together to give an overall regional geology. From this a neat bound report had to be produced and a suntan to be shown off.

NEWS



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PROGRAMME FOR 1984

January 13th	Annual General Meeting.
February 19th	Dr. L. M. Lake. No title yet.
February 17th	*Annual Dinner at the Maltings. Our after* dinner speaker this year is Rab Colvine.
March 9th	Dr. Ruth Osborne, of the Imperial College, London, will talk and show slides about "An amateur geologist in Canyon Country". The 1981 G.A. trip to Western U.S.A.
April 13th	Dr. Jane Francis. Bedford College, London. The *Palaeoecology of the Lulworth Forest is the* title of Dr. Francis' talk.
May 11th	Dr. Bill McGuire, of the West London Institute of Higher Education is going to revive memories for some by talking about the Mount Etna Volcano.
June 8th	Dr. R. Goldring, University of Reading, is going to take us 'down under' when he talks about "The Ediacara Fauna of South Australia".
July 13th	Members Evening. How would you like to spend the evening? Suggestions to the Committee by May.
August	No meeting. A chance to nip away and practise your geological skills.
September 21st	Bob Whitehead from Farnborough College of Technology is paying a return visit to talk about "The Effects of Geology on Scenery".
October 12th	Dr. Ellis Owen, Natural History Museum, is *going to talk* about "*The Zonation and General* Stratigraphy of the Chalk".
November 9th	Dr. D. Hamilton, University of Bristol, will be talking about "Sediment Movement on the Sea Floor South West of Britain".
December 14th	For our Christmas lecture Prof. Janet Watson will talk about "Mineralization in Relation to the Evolution *of the Earth's Crust*". *We will end this* meeting by enjoying some Christmas fare.

NOTE FOR THE GUIDANCE OF AUTHORS

Papers and article on any topic within the earth sciences are welcomed especially those of local interest. Short papers of 2000 words or less are preferred although longer papers not exceeding 5000 words can be accepted.

Two copies of the typescript should be sent to the Editor. Typescripts should be doubled-spaced, including references, on one side of A4 paper with a wide margin on the left and a narrower margin on the right. All pages should bear the author's name and numbered serially.

Papers and articles should be arranged as follows:

1. Title, brief and specific.
2. Name of author(s).
3. Summary: this should not exceed 100 words.
4. Address of author(s).
5. Main body of paper or article: subdivided into separate headings which are to be numbered serially.
6. Acknowledgements.
7. References.
8. Legends for text-figures and plates (if any).

Measurements should be given in S.I. units. Standard palaeontological and stratigraphical conventions should be followed throughout the text. Generic and specific fossil names to be italicised throughout. Localities referred to in the text should be precisely located by their Grid Reference or by an appended index map.

References should be listed alphabetically by author at the end of the paper. Attention should be paid to convention as regards the abbreviated titles of journals. Authors are responsible for the accuracy of their references.

Figures used to illustrate articles should be prepared at twice the size of their eventual reproduction. Any letters or numerals should not be less than 1mm high after reduction. It is suggested that white card or a colourless tracing medium be used with black indian ink and dry transfer lettering.

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