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EDITORIAL

The State of the Empire

"I've heard it said" a well-known figure once remarked to me, peering owlishly through the haze of his own crapulence,"that speleology is both a science and a sport. What's your answer to that?"

My answer to that was to choke back my tears of frustration and hurry away before he could voice the further profundities that i could see fighting for liproom. "A way of life, perhaps?" Certainly it is a science, sport, art, profession, disease, what-have-you. So is immorality, but what libertine ever paused to ask himself whether his way of life was really a sport or a profession, and if both, how his amateur status stood. It is only, god help us, speleologists who indulge in this welter of introspection.

I suppose if a set of rules and funny clothes are criteria then speleology is a sport, and if technical jargon and painstaking endeavour make up a science, then it is a science. This need to categorize is a pity, since it robs the activity, or inactivity, of its flexibility. While it is sufficiently shadowy and undefined, people are free to put their own interpretation on it. In this way there can be no "aspeleology"; speleology is all-embracing so that whatever you do must by definition be in the interest of speleology, even though it may be unsportsmanlike, or unscientific, or downright irresponsible.

In taking this stand I am not decrying the scientific, or pseudoscientific aspects of speleology. It gives me a strange joy to turn up references in the literature to paraphreasis and cryptodavosity; or again, to read with bated breath, how one group, on hearing that a cave was about to be demolished by quarrying, spared no effort to get it mapped while there was yet time, showig an enthusiasm which would make Casteret turn in his cave. My argument is with the do-gooders and witch-hunters who in their analytic fervour want to suffocate speleology in teleology, and limit its scope to the compass of their own one-track narrow-gauge little minds,

The State of the Union

A welcome morsel of late news is the discovery of a completely new cave at Jenolan by the Society's Jenolan axis. This is in marked contrast to the results produced in the Mammoth by the painstaking endeavours of more than a year. The Northern River Section apparently fades away. Such a discovery as this puts SUSS back in the limelight, and it is surely necessary to make such a discovery as this from time to time to preserve the cavers from immolation in the fore of frustration. The discovery of a completely new cave in an area as intensively

scrutinized as Jenolan demonstrates that much is still to be gained from surface exploration. In the life of SUSS Jenolan has yielded up the Chevalier, the Serpentine, and the Casteret. Much is also to be learnt from the fact that the Casteret was discovered by an intrepid band "....resting after emerging from the Foz Hole".

The State of the Society

Although the Society began this year in an atmosphere of thunder and lightning, it failed to transform it into one of thunder and glory, and seems to me to have lapsed into an unwonted tameness, indeed almost an early senility. Maybe the annual rebirth in the long vacation and during first term will restore the glory of the days of old. While this Journal is as unconscionably late as any of its predecessors, I shall be well satisfied if SUSS rises phoenix like from its ashes.

Tom Landecker

MAMMOTH, MORE MAMMOTH

A report on recent exploration of the Mammoth Cave at Jenolan, N.S.W.

TED ANDERSON

A report on exploration of the Central Level and Northern River Section of the Mammoth Cave at Jenolan appeared in SUSS Journal Vol.6 No.1 (pp 25-26) by Ian Williams. This exploration was carried out in the period up to and including Easter 1960. Since this date exploration of these parts of the Mammoth has steadily continued and a number of interesting discoveries has been made. The Northern River Section has been visited a further five times and about forty five hours have been spent underground in an effort to remove the many question marks from the sketch maps of the Northern River Extension; an earlier trip report suggested that a better name could possibly be found for this extension. It could simply be called The North Tunnel. The time spent produced rewarding results, as the following report and the accompanying map, modified from the 1960 map, will show

Note: Various people have, on recent trips, given names to many of the features in this part of the Mammoth, which previously were numbered for reference to the map. The printable names will be adopted in this report.

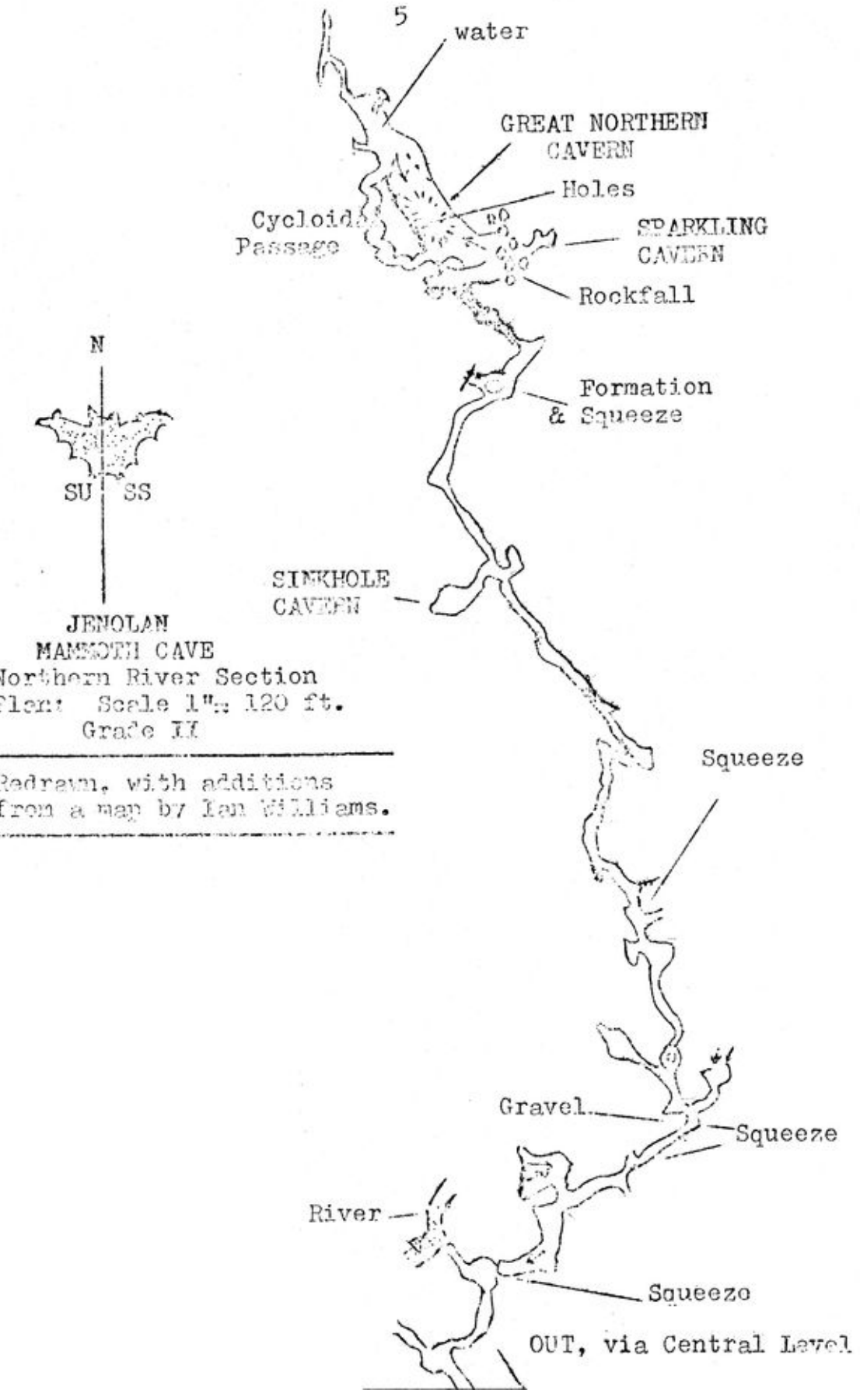
The "...several holes in the roof of cavern)9(...", (Sinkhole Cavern), referred to in the earlier report were explored on 1st May 1960 by a party led by Ian Williams. The difficult climbs up the near vertical, slippery mudslopes and in the "holes" in the roof of the cavern produced no notable discoveries. No branch tunnels at any higher level above that of the main tunnel were found.

During a trip led by Henry Shannon in December 1960 a small independent party of three spent a single day at Jenolan. The aim of this visit was to enlarge the impossibly small squeeze situated about 60 feet beyond Sinkhole Cavern which had prevented further exploration of the North Tunnel on previous trips. This squeeze, Formation Squeeze, (It was called many other names), was successfully negotiated after the removal of some thin but hard limestone projections, and a further 100 feet of low, narrow, and very muddy tunnel was entered. This tunnel, which includes a right-angle bend, was found to lead to the largest cavern yet discovered in the Northern River Section

To answer many questions arising out of the discovery of the Great North Cavern a group of three set out during the Jenolan Freshers' Trip in March 1961 to explore the possibilities. The cavern was reached and some exploration beyond that of

previous trips was done, but since little time was available and carbide lamps had almost run out of water the party was forced to return. One nOtable accomplishment during this trip was the forcing of another squeeze, only a few feet away from Formation Squeeze, after digging out some mud and fine gravel. Consequently a choice of routes is now available and future explorers can get stuck in whichever squeeze they prefer.

With the difficulties involved in exploration of this part of the Mammoth now fully appreciated, a well organised group of six (including the three members of the previous trip), led by Dave Anderson, set out on 26th March 1961 to "explore to the limits". To enable the greatest possible speed of travel in the cave the group split into an exploration party of four and a support party to carry in extra carbide and water as well as a small stove to prepare hot soup and other food. The Great North Cavern was estimated to be about 40 feet wide, more than 100 feet long, and about 70 feet deep from the smooth level ceiling to the lowest point reached in a gravel floored sump. A rockfall was discovered at the South East corner of the cavern. This rockfall appears to consist of large slabs of rock which have collapsed from the "hanging wall" of an overwidened joint in the limestone. The joint has an approximate North West to South East strike and an average dip of about 60° to the South West. It is possible that the whole collapse did not occur at the same time, but that sections of the hanging wall collapsed at varying intervals, whenever the supporting limestone above was sufficiently weakened by crevice enlargement due to physical and chemical action, particularly water action. This would account for the fact that exploration above the rockfall has, to date, disclosed no cavern etc. from which the rock might have come. The only chamber so far discovered above the rockfall (Sparkling Cavern), has small dimensions (20 feet across and 30 feet high) and does not appear to be the result of rock collapse. Incidentally, this cavern contains a small quantity of very good formation, including pure white and translucent helictites and miniature canopies, and as its name suggests has walls which sparkle with a bright white light, despite the thin covering of mud in many places. Evidence of apparently recent movement of parts of the rockfall was noted when clean chips of limestone and formation were found in exposed positions on soft, wet mud. Another feature of the Great North Cavern worthy of description is the exceptionally fine example of a serpentinious passage running parallel(?) to the South West side of the cavern. The passage can be entered below a 15 foot drop in the SW corner of the cavern near some very fine formation. Rather than serpentinious, the plan of the passage is very roughly cycloidal with sudden changes in the direction of the passage forming cusps. These cusps have, on the internal,



JENOLAN
MAMMOTH CAVE
Northern River Section
Plan: Scale 1" = 120 ft.
Grade II

Redrawn, with additions from a map by Ian Williams.

side, particularly sharp water-carved limestone projections. The passage re-enters the cavern further along the same side.

On the farthest side of the cavern, across the many holes in the floor, a steep mudslope leads up to a level similar to that from which the cavern was entered. A number of small holes were found in the ceiling at this point. One of these holes, although too small to negotiate, has a small but not insignificant flow of water which runs down the smooth wall and makes a clearly defined course across the floor towards the cycloidal passage. Very little water was actually flowing at the time of observation. Another hole close by forms a sloping passage or chimney in the roof which is apparently blocked in both directions at the top. The tunnel does continue past here at about the same level as before but digging may be the only method of following its course any further. Most of the exploration of the North Tunnel and particularly that around the Great North Cavern has been carried out in a systematic and thorough manner, but there remains still a number of holes and squeezes etc, some of which may have to be dug out before entry is gained, which could lead to even more Mammoth.

At last, plans have been made for a scheme to map, as well as possible under the conditions, the entire Mammoth Cave. Such a map will probably involve spending a considerable amount of time underground, and, it seems, an even longer time between trips spent drawing up the results. To date the greatest drawback has been the limited time available to interested members, so that trips are hard to arrange. Generally, the methods of mapping will be to establish a few high grade, accurate traverses from the entrance along the main levels of the cave such as Central and Lower Levels. By using a theodolite with compass checking, and triangulation where it is thought necessary as well as closing the traverse when it is possible, it is hoped that the main direction and distances will be plotted with reasonable accuracy. This accuracy is necessary to determine the position of the main tunnels in relation to surface features and other caves, as well as the surface creek course. The outlines of the tunnels and the many side passages can then be mapped more quickly at a lower grade and then superimposed upon the accurate survey.

The outlines of the "Railway Tunnel" in Central Level have already been mapped by SUSS and a theodolite traverse from the entrance to the Railway Tunnel has been made in the past. During 27th and 28th May 1961 a party of five continued this theodolite traverse along the Railway Tunnel and down a shaft to the river in the Northern River Section. To preserve accuracy in carrying the direction down the shaft it was considered necessary to plot two separate but linked lines of sight in the manner of triangulation. This course proved to be a wise one to adopt since a number of readings with a vertical depression of over 70 degrees were encountered, with one close to 80 degrees. This traverse is in the process of being drawn up, and to date the errors in triangulation are in the order of 1 inch in 100 foot sights in the plan. The traverse has yet to be closed on a future trip

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BATS.

BARBARA DEW

El articulo expone lo que se conoce sobre los murcielagos que habitan las cuevas de Nueva Gales del Sur, describe los metodos que se emplean para estudiarlos, y determina los problemas que aun quedan por resolver.

Las especies mas comunes son Miniopteris Schreibersi, Rhinolophus Megaphyllus y Myotis Macropus. Se llevan acabo tambien estudios sobre la emigracion por enanillada y estudios sobre los parasitos.

Fifty five species of bat have been recorded on the Australian mainland, and of these all but eight, which are fruit and blossom eating bats, belong to the sub-order MICROCHIROPTERA which are insect eaters. Of the fruit bats, not all are pests, and in fact only two or three species cause much destruction of fruit, and what they do has often been exaggerated. It is not known how many of the 55 species inhabit caves.

Bats usually produce one young each year, the time of birth usually lying between late November and early January. The young bats are born blind, and, having no fur covering, are pink in colour. Being mammals, bats

of all species feed their young on milk. The mothers of some species carry their young around with them as they forage for food. Our commonest cave species, MINIOPTERIS SCHREIBERSI, does not carry its young, but leaves it hanging up in the cave, which is both the breeding ground and the nursery, while it is away feeding. One of the main breeding caves of New South Wales is at Wombeyan, and it is only due to lack of investigation that the others which must exist have not been found.

Since the foundation of S.U.S.S. in 1948 and the issue of the first journal in May 1950, the published reports, and the more frequent unpublished trip reports, have contained an assortment of data on bats. Bats of one species or another have been reported from the following cave systems:

Comboyne (December 1949)
Borenore (July 1952)
Tuglow (July 1952)
Narrangullen (May 1953)
Colong (May 1953)
Buchan (January 1954)
Wombeyan (January 1955)
Bungonia (March 1955)
Yessabah (May 1957)
Wyanbene (June 1957)
Cliefden (April 1960)
Timor (July 1960)
Jenolan (August 1960)

Some of these reports stated sex and species, but usually no information is available. Most reports are for MINIOPTERIS SCHREIBERSI, but there are one or two references to RHINOLOPHUS MEGAPHYLLUS, and one for MYOTIS MACROPUS. One of our most interesting records is the extension of the range of both MINIOPTERIS SCHREIBERSI and RHINOLOPHUS MEGAPHYLLUS by some hundreds of miles by the report of the species from Buchan. Both species were lodged at the Australian Museum, Sydney (M.7823, M.7824).

In March 1955 the Drum at Bungonia was entered and 90 bats were captured in about one hour (61 males and 29 females). All seemed to be overcome by foul air, but there was some doubt as to the verdict. On another occasion I found dozens of dead bats still hanging on the wall. During this visit the foul air was not very obvious where we found the bats, but a short distance along the passage it became very obvious, and so the

question was raised, does foul air kill bats, or was this some other mortality. Unfortunately the bats were too mummified to allow any useful autopsy. If any other person should notice a similar effect either at Bungonia or in any other area, observations and specimens would be very useful. On both occasions the bats were the common bentwing bat, MINIOPTERIS SCHREIBERSI.

Bats have been examined for parasite infection, and to date have provided some interesting material and information. Their ectoparasites include ticks, mites, wingless flies (NYCTERIBIDAE), a small winged fly (STREBLIDAE). This last is of special interest as it has not been reported from a MINIOPTERIS in Australia. Flies have been reported from other areas, but to date none have been reported from the local NSW bats. The intestinal parasites include flukes, tape worms, a heart worm, a round worm, and some kind of blood fluke. Blood, on being examined, has been found to contain microfilaria of the heart worm, and a malaria-like organism, PLASMODIUM SP.. Investigations in bat parasites will continue, and it is hoped to do something on their life cycles. This is a complex investigation, and a great deal will have to be done. The most interesting finds, according to the experts, are to be found in the samples of guano sent in for examination. These have provided a great variety of life, including flies, moths, beetles, mites, cave scorpions, crickets, termites, and spiders. The mites have created special interest, and more samples are urgently needed, so send it in, no matter how small, but the bigger, within reason, the better. It is best collected in plastic bags, and should have a label telling place and date of collection and collector's name. The material should be sent to me at the university.

Interest in bats has been further stimulated in the past few months, when permission to band bats was obtained from the Chief Guardian of Fauna and the CSIRO. The aim of banding bats is to determine the pattern of their migrations. To date bats have been banded at Jenolan (200), Wombeyan (471), North Sydney railway tunnel (633). The bats in the tunnel appear to be a changing population, as on all our visits we have found different groups. The first visit was on 13th August 1960, and all 20 bats examined were males, and the estimated population 100. On 28th August 1960 a further visit was made and 200 bats banded, chiefly females. As well as the bats banded, there were at least 2000 on the wing. The third visit was on 8th October, and

the bats were too active to catch. Since then other visits have been made, including one in early June when 200 odd bats were banded. The method of banding is as follows: a bat is caught in the long handled bat net, the band, which is a small aluminium ring bearing a number, is closed over the forelimb without piercing the skin, and the bat is then released. The greatest number of bats banded at one time to date was at Wombeyan Caves on 30th April, when 259 bats were banded and over 100 released owing to lack of bands. The special interest of this group was the very high proportion of juveniles. One is led to wonder if we may not have another breeding colony. Among this group was a banded bat, banded at Wee Jasper just before Easter.

SUMMARY.

MINIOPTERIS SCHREIBERSI has been seen and identified from the following caves or artificial shelters: Buchan, Bungonia, Burrinjuck Dam, Cliefden, Colong, Jenolan, Narrangullen, North Sydney railway tunnel, Mount Fairy, Timor, Tuglow, Wombeyan, Wyanbene, Wee Jasper.

RHINOLOPHUS MEGAPHYLLUS: Buchan, Comboyne, Timor, Wyanbene.

MYOTIS MACROPUS: Narrangullen.

This list is not very impressive compared with the list of places where we go caving. What is needed is a little more co-operation. We want reports of the occurrence of bats, but reports are of little value without identification, and so we prefer to have specimens or at least skulls.

THE MACLEAY VALLEY

C.CARTER and R.SAUNDERS of the
KEMPSEY SPELEOLOGICAL SOCIETY

The Macleay Valley, for the most part, consists of Permo-Carboniferous deposits throughout its length, except for small areas of Pleistocene and recent gravel and alluvial beds immediately adjoining the river. As our main interest centres around the limestone deposits, we will confine ourselves to a series, possibly Permian, known as the Macleay Series. The lowest bed of this series comprises in the main, purple varve shales containing scattered pebbles of various igneous rocks of the acid and intermediate groups. The upper strata of this bed have a tendency to be calcareous. A great number of the pebbles contained in these beds are striated, thus it is thought that its origin was in glaciation.

The Glacial beds are overlaid by a limestone bed varying in depth from 100 to 500 feet. The base and top of this limestone bed contain many mudstone bands of varying thickness which are crammed with Fenestellidae. The main band of limestone itself is Crinoidal, with an even crystalline texture throughout and is nearly pure Calcium Carbonate. The predominant colour is a pale pink, while in places brown, grey, purple mottled and white may be found. The limestone of this area is ideal for ornamental stonework - the columns of the Sydney art gallery were cut from Temaroo.

The limestone, where exposed, weathers to a grey colour and becomes fluted. Fossils are seen only on weathered and polished surfaces and comprise mainly Crinoid ossicles, with patches of shells such as Spirifera, Productus and Pectens. The limestone also contains isolated patches of pebbles and their presence may indicate the persistence of icebergs from the ice age which seems to have preceded the growth of the marine fossils forming the limestone. Patches of fine reddish powder (volcanic ash?) filling isolated pockets within the limestone may indicate possible volcanic action during this period.

The Crinoidal limestone bed is topped by silicified limestone beds of varying thickness. In places where these beds have been subject to weathering, the calcium carbonate has been dissolved leaving a porous mass of silicified fossils and where Monilopora predominates, the resultant weathered mass resembles compacted macaroni. In places these silicified limestone beds are separated by Crinoidal limestone. Above these again lie calcareous mudstones containing Fenestellidae, and these are in turn overlaid in some areas with sandstones containing Pectens, and in other places with tuffaceous beds.

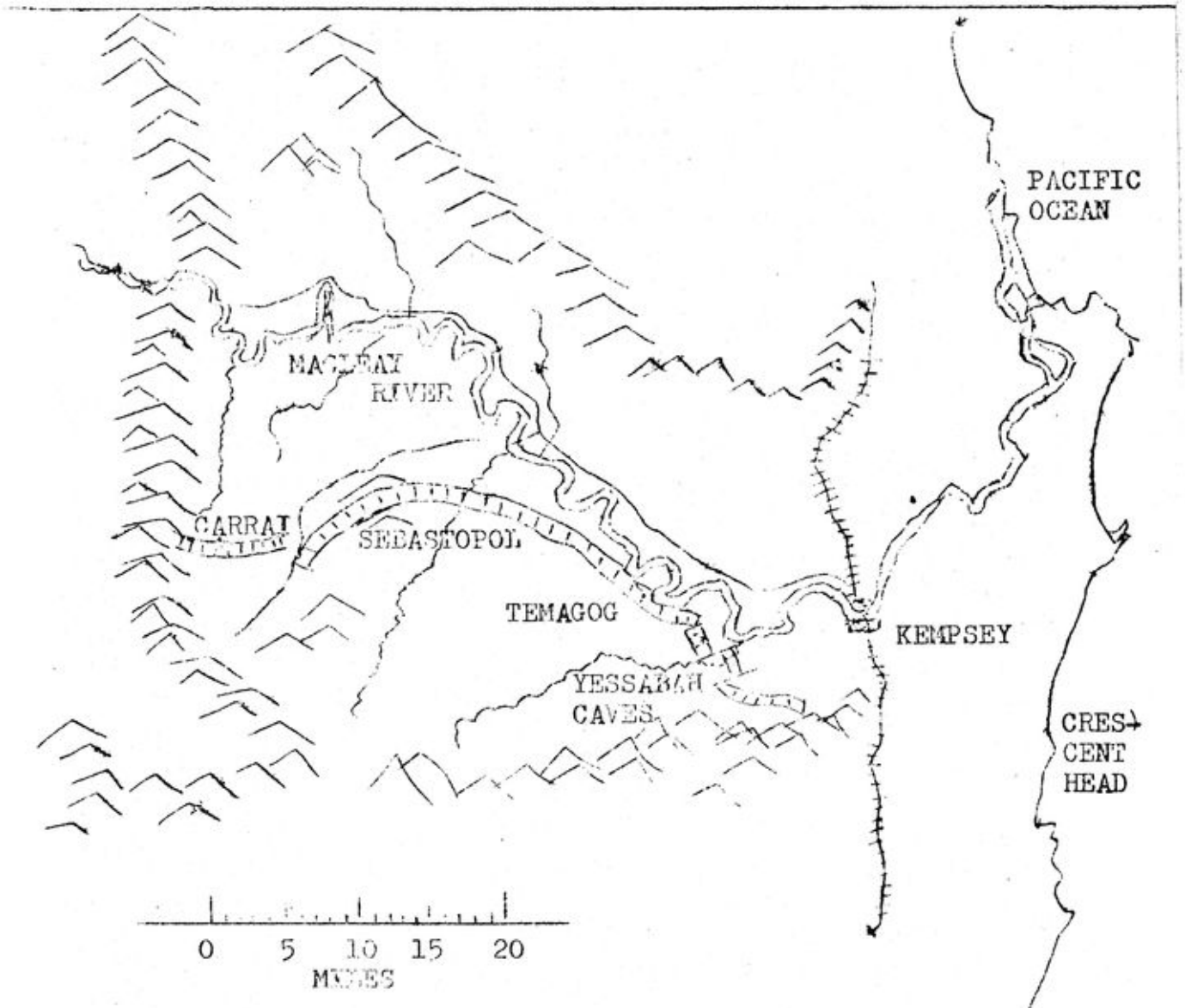
The Eastern boundaries of the limestone are not accurately known as they are overlaid by more recent deposits. The first outcrop occurs at a point about 8 miles S.W. of Kempsey, from where it runs in a N.W. direction through three distinct faults until it reaches the bank of the Macleay River about 8 miles West of Kempsey. It then runs in an unbroken gentle curve tending westward to Willi-Willi, about 25 miles W.N.W. of Kempsey. From Willi-Willi the general direction is S.W. through rugged forest country and numerous faults in this area render it too difficult to describe accurately. The series ends along a possible fault line in the scarp of the New England tablelands.

From south of Kempsey to Willi-Willi, the limestone outcrops through undulating country following the floor of the Macleay Valley. This area was open forest country, large portions of which have been converted to grazing lands. From Willi-Willi to its western limits, it passes through steep sided hills reaching a maximum height of 3,800 feet, clad in dense rain forest, with some patches of open forest. This area is unpopulated and is virtually virgin land, so no geological mapping or survey has been carried out in this section so far. We as a society have only been able to explore a very small portion of this area and nothing is really known of its extent or possibilities.

The mean average temperatures of the area are 80 degrees maximum and 55ddegrees minimum (Fahrenheit), the average rainfall is 52 inches falling mostly in late summer and early autumn. The predominant vegetation is Eucalypts with coarse natural grasses in the lower areas, while the rain forests consist of softwood timbers with Beech, Coachwood, Ash and Cedar in the main, laced with vines, ferns, orchids and mosses. The open forest country in the hills contains many Macrozamia and Xanthorrhoea (grass trees).

The animals of the area are the Koala, Echidna, Possum, Wallaby, Kangaroo, and many other small marsupials, Dingo, Fox, Rabbit, the usual snakes, with Lyre-Birds, Bower Birds, Bell Birds, Kookaburras, Kingfishers, Honey Eaters, Pidgeons, Magpies, and in fact all birds indigenous to Eastern Australia are represented in the area. We must make special mention of Finches, many varieties being represented in the lower grass lands, and of Parrots of many kinds who make their home mainly in the upper Macleay forests.

The full extent of the caves in this area is not yet known as the limestone outcrop is too extensive for our limited membership. From the areas so far visited and explored it would appear that these limestones contain a large number of caves,



MAP OF THE KEMPSEY AREA, SHOWING THE MACLEAY VALLEY LIMESTONE

none of which is very extensive. The difficulties in locating our caves may be realised from the fact that all but a few have vertical entrances only a few feet across, making it hard to discover their location. Much time is wasted searching for these holes. If they occur in grazing country they have been left covered with scrub, while in the rain forest areas the undergrowth hampers our search.

To date about 70 caves have been found which extend more than 30 feet, the largest being 400 yards long (surface distance). Most of these caves are not large in width or depth and the majority contain dirt floors of unknown depth. Most of the caves peter out into small pipes, or the passages are choked with either dirt, rubble or formation. About half the caves visited contain lime formations and all varieties of formation have been seen in one or more caves. The largest formation found so far has been only of medium size, but the formations, although small, are in many cases excellent. No known cave ib our area contains a stream or river and this may account to some extent for their lack of size. No signs of habitation by man have been found, but the caves have obviously been used by animals. Some of the caves contain extensive bone deposits- mainly those of bats, rodents and small marsupials.

Large colonies of Bent-wing and Horse-shoe bats have been found in a number of the caves. Insect life includes glow worms, millipedes, spiders, centipedes, slaters, cave crickets and many varieties of small mites. There are many kinds of fungus present in and around the caves.

No description of the Macleay cave areas would be complete without mentioning the excellent scenery along the entire length of the limestone outcrop. Along the lower Eastern end of the outcrop, beautiful views of some of the finest grazing lands of the New South Wales coast are to be found, with glimpses here and there of the rich Macleay Valley river Flats beyond. Around the parklands of Willi-Willi, at the foot of the high country, nearly every view is a "calendar" shot and the beauty of this area in the early morning or late evening has to be seen to be believed, while at the western end of the outcrop in the rugged hills and the Carrai plateau, mountain vistas equal to any in Australia open up to those who clamber up to vantage spots. Just beyond Haydonville, near the start of the track down to the Carrai Bat Cave, an excellent view of the Macleay River mouth and the coast is to be seen, some fifty miles to the east.

Many flowering trees and orchids beautify the bush over much of the year, but perhaps the rain forest is at its best in

the late spring when the flame trees (Brachychitons) are in flower, making vivid splashes of scarlet along the hillsides.

The access roads are of good surface, though narrow and in places steep, but unfortunately (as some of our members know to their sorrow) are not "all weather" roads, numerous creek crossings being subject to local flooding. Good forestry roads built over the last twenty years to tap the excellent stands of Cedar and Coachwood of the Carrai Plateau have opened up for us-- to some extent- the western limits of the limestone, and it is in this uninhabited virgin country that we hope to find a really extensive cave system. Timber getters often report big "holes" to us that they have seen while looking for their timber, but when - and if - we locate these holes, they prove to be just "holes", pinching out after one or two hundred feet.

Before closing let us report that we have been unable to locate the large cave system at Sebastopol, reported in many early books on the Macleay Valley. It is the writers' opinion that these caves are those now known as Willi-Willi, and the Willi-Willi caves of those early books are a series of small holes some two miles away on the southern side of Willi-Willi creek, now nameless and lost amidst a tangled mass of Lantana. However the country around Mount Sebastopol is very rough and covered with undergrowth, and it is possible that a good cave system exists here waiting to be rediscovered.

The Kempsey Speleological Society is ever ready to meet and entertain visiting speleos and to show them over the limestone area of the Macleay Valley, or just to meet them and pass the time of day as they pass through our district. Our President has a very good coffee lounge in Clyde Street near our main theatre. If you are heading our way make a note of the following names:-

Bill Dalton-Webb, Clyde Street, phone 3643 -- President
Col Carter, 4 Albert Street, phone 3855 (H) 2236 (W)
Dick Saunders, Gilfillan Avenue, phone 3855 (H) 3247 (W)
Vince Wall, 59 River Street, phone 4105 (H)

COLONG RE-VISITED

Colong JOHN LOTZ

The last three trips to/have not been without event, and it will be interesting to see if this state of affairs will persist. In the first of them, the now almost mythical Oldsmobile was wrecked (and still decorates the Mt. Werong road in mute obituary). The next trip was the abortive attempt to

walk in through Burragorang Valley, and on the last one a considerable fall of snow rendered the road such an insult that a utility truck and a Land Rover were both decisively bogged.

In spite of these deterrents, access to Colong is now in some ways better than ever, the only disadvantage being that a rather long drive (170 miles) is necessary. This means getting to the Oberon district and then following the Taralga road and Mt. Werong stock route to the gate of "Bindook" property. From here a not impossibly difficult walk of about two miles is all that is needed to reach the caves. This track has been blazed with aluminium discs by the S.U.Rover Crew and is impossible to miss.

The last trip (in August) discovered nothing new, though an attempt was made to do some surface work in spite of the aforementioned inclement weather.

Trickett reports three caves in the area (not including Billy's Ck. and Church Ck.), to wit: the present well-known system and two other caves, the Coral Cave and the Red Cave. As far as can be ascertained, neither of these latter caves has been seen in recent years. The Coral Cave is reported to be upstream and on the other side of Lannigan's Ck., where there is quite a good limestone massif. The Red Cave is supposedly directly opposite the Colong arch. This cave was sought in August but without success, though the hillside was far from completely examined.

Two more banded bats were captured. These had been banded by Barbara Dew at Wombeyan in March. (In January 1960 a bat from Wee Jasper was recovered at Colong)

The main system holds much of interest for any speleo, and particularly photographers, but of high priority is the re-discovery of the two lost caves in the area. A trip has been proposed for this coming December, and may be fruitful in this regard.

THE ORIGIN AND BEHAVIOUR OF FOUL AIR

DR. FAUNCE'S THEORIES EXPLAINED AND REVIEWED

WARREN PECK

During 1956 Ted Faunce, later to become Dr. Faunce, wrote an article for this journal outlining his theories on the origin and behaviour of foul air. The paper was never published, and the manuscript prepared for publication was apparently lost, but the rough notes from which it was prepared were given to the author by Dr. Faunce.

Prior to Ted's formulation of his theories, an article by Peter Moodie on the subject of foul air (SUSS vol.1 no.3) stated that there were two sources of foul air:-

1. Falling rainwater dissolves carbon dioxide from the atmosphere, and this dissolved carbon dioxide reacts with limestone to form soluble calcium bicarbonate. When this seeps through to the roof of a cave, it evaporates liberating carbon dioxide and depositing limestone as cave decorations. The carbon dioxide is gradually concentrated in poorly ventilated caves, resulting in foul air.
2. The decomposition of animal and vegetable products washed underground also liberates carbon dioxide.

In the same issue of the SUSS Journal, Denis T. Burke published the following analyses of seven foul air samples from the Drum, Bungonia (see Note A at the end of this article).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Atmosphere
CO_2	4.2	4.3	3.9	4.8	5.0	5.0	4.5	0.03
O_2	15.5	15.5	15.7	14.6	14.5	14.6	14.8	20.93
N_2	80.3	80.2	80.4	80.6	80.5	80.4	80.7	79.04

The previously published theories on the origin of foul air were dealt with in Ted's notes in these words:-

"The usually accepted hypothesis is that carbon dioxide is dissolved in water when rain is falling through the air; this carbon dioxide is later given off as the water evaporates. This is a very neat idea, coupling the production of cave formations with the production of foul air, but it is only an idea, and not a very good one at that, because it fails to explain a number of facts."

These facts were noted:-

1. Foul air occurs in wells (typical analysis: CO_2-4.5, O_2-13.7, N_2-81.8) where little water evaporates.
2. If foul air was the result of simple addition of carbon dioxide to normal air, as proposed by the above theory, both oxygen and nitrogen should be diluted, i.e. be present in lower concentration than in normal air; yet the concentration of nitrogen

is slightly higher in foul air and the carbon dioxide is present solely at the expense of oxygen.(Note B)
3. Methane can be present in the foul air of wells (and may also be present in caves, although no one has yet tested specifically for it).
4. One litre of rain water at 16°C cannot dissolve more than 0.15 mls. of carbon dioxide. Therefore to obtain one litre of carbon dioxide it is necessary to evaporate at least 6600 litres of rain water; To obtain one litre of foul air containing 5% carbon dioxide it is necessary to evaporate at least 330 litres of rain water. In other words, for a cavity to be filled with air averaging 5% carbon dioxide, assuming no loss due to draughts, the cavity must have evaporated at least 330 times its own volume of water, which is difficult to believe. (Note C)

The Source of Foul Air

Ted noted that "most articles about foul air have one line saying that the decay of organic matter might contribute slightly to the foul air". He was of the opinion that a very high percentage of foul air is the result of this decay.

"The decay of dead animal and vegetable matter in the soil is brought about by living organisms, bacteria, fungi, protozoa, and some small metazoa such as worms and insects, even ants. In any bushland or rural area, the waste organic matter is quite considerable, and so is its rate of turnover.

"As well as liberating carbon dioxide, and sometimes methane, these organisms use up oxygen, which accounts for the low oxygen percentages in foul air samples. The rise in nitrogen percentage is explained as follows. If carbohydrates are metabolised, the volume of CO_2 liberated is the same as the volume of oxygen used, for an example consider the decomposition of glucose:

$$C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O$$

However if fats, fatty acids, or proteins are metabolised, the volume of carbon dioxide liberated is less than the volume of oxygen used, viz. the case of a fatty acid:

$$C_xH_{(2x+1)}COOH + (2x)O_2 = (x+1)CO_2 + (x+1)H_2O$$

or again the case of glycerol:

$$2C_3H_8O_3 + 7O_2 = 6CO_2 + 7H_2O$$

Proteins act similarly (Note D).

The following figures for the ratio of carbon dioxide liberated, to the volume of oxygen used, in the metabolism were given:-

for carbohydrates ratio CO_2/O_2 = 1
for fats the ratio is about 0.7
for proteins the ratio is about 0.8

Ted stated that as the organisms mentioned above consumed all three types of foodstuffs, the overall ratio of carbon dioxide liberated to oxygen used is less than unity. This would result in a decrease in the total volume of air, but as there is no change in the volume of nitrogen, the percentage of nitrogen will be greater in foul air than in normal air (Note E).

The Behaviour of Foul Air

The foul air produced by these organisms in the soil is slightly denser than normal air and Ted considered that the foul air would sink deeper into the ground and would flow through small holes and crevices like water. Furthermore in some regions he thought that it forms a foul air table, similar to a water table; but since it is only slightly denser than air, the foul air is affected by air currents and barometric pressure changes.

"When the barometric pressure rises, air is forced down into a cave or well, and from this into the voids in the surrounding rock and soil. Foul air is driven by this pressure back into the ground and the cave (or well) is left filled with normal air. Conversely, when the barometric pressure falls, the foul air flows into the cave from the surrounding rock."

The presence of a minimum foul air level in some caves, analagous to the Zone of Permanent Saturation in ground water studies, is postulated. Some caves have no foul air because the ventilation is too good to allow it to [illegible] in the cave, as is the case at Jenolan.

Ted concludes: "One very characteristic feature of foul air is the way it is in layers; it flows in silently like an invisible liquid and rises as a growing pool on the floor, in a layer which can extinguish a candle, a troglamp, or the unwary troglodyte."

Ted Faunce's Theories Reviewed

During 1958 much data on the composition of foul air at Molong and Wellington was obtained by Noel Fraser (see SUSS Vol.5 No.1) using the society's Fyrite Indicators which give consistent and fairly accurate results (Note G). The data available to Ted in 1955 and 1956 was from only one area with carbon dioxide concentrations within the narrow limits of 3.9% and 5.0%. Noel Fraser's analyses cover carbon dioxide concentrations between 2% and 13.5% from two areas. In nearly all cases the concentration of nitrogen was either the same as in the atmosphere or a little higher. In every case the percentage of oxygen decreased in proportion to the increase in carbon dioxide concentrations.

Noel Fraser on examining the results (and quite unaware of Ted's theories of 1956) arrived at the following conclusions; "The data appears to indicate that the carbon dioxide is generated in or near the cave itself, and so merely replaces oxygen which has been used in its production. The process is probably one of organic decomposition." This is similar to Ted's conclusions from

the data of Denis T.Burke, but he considers most foul air to be generated at the surface, in the soil, and not in or near the cave itself, (Note A).

Some information which strengthens the soil theory is now available. Firstly, research in England has shown that air trapped in the soil contains between 0.75% and 3% carbon dioxide. Secondly, rain water in equilibrium with air containing 0.03% carbon dioxide is capable of dissolving 63 parts per million of calcium carbonate at 60° F. However the water seeping into caves through their roofs has been tested, and up to 1000 parts per million of dissolved calcium carbonate found. In order to dissolve 400 ppm. of calcium corbonate, the water must have been in contact with air containing 6.3% carbon dioxide (at 60° F). Since some of the water samples were obtained in areas where no caverns with foul air have been reparted, it is logical to conclude that that the water encountered the high carbon dioxide concentrations in the soil and rock above the cave. This is interesting, as Ted Faunce believed that foul air is available everywhere, and, but for good ventilation, foul air would accumulate in all caves.

These theories on the behaviour of foul air neatly tie in with all data at present available. Whether Ted's "Foul Air Table" is a valid concept or not may well be a subject for controversy. In conclusion we must give the late Dr.Faunce considerable credit as the originator of this hypothesis, the first to explain all data at present available concerning the occurrence and distribution of foul air in caves and wells.

NOTES ON THIS ARTICLE, contributing to the evaluation of the theories propounded above, prepared by Kel Stillman and Tom Landecker.

Note A: There is some danger in comparing analyses of foul air from two caves of vastly different size. The Drum at Bungonia is 150 feet deep, and bell shaped, with a base approximately 60 feet square. The caves at Wellington and Molong from which the other readings are taken consist mainly of small passages usually about six to ten feet high, or of narrow vertical shafts. In any case, the volume of these caves is no more than one tenth of that of the Drum. Consider for example the effect of the CO_2 production of a carbide lamp. A carbide lamp produces about 20 litres of carbon dioxide an hour, and a party of five staying in a small cave for an hour or even longer (as was the case when the Wellington or Molong readings were taken) can easily raise the carbon dioxide concentration by 1 or 2 per cent. This CO_2 is produced at the expense of the oxygen, giving a rise in nitrogen concentration as noted above. While

a 2% increase is easily detectable by accurate analysis, an increase of 0.2% would be easily missed or ascribed to an error of analysis. In other words, in a cave the size of the Drum the carbide lamp can be ignored as a source of foul air, while in a small cave it cannot.

Note B: That the nitrogen concentration in foul air is higher than that in the atmosphere is the best substantiated of the facts enunciated in the article. The method of analysis used to arrive at the figures for the Drum is a reliable one (Haldane Gas Analysis Machine), and one much more accurate than the Fyrite indicator method, (see Note G)

Supposing that foul air is generated by the simple addition of carbon dioxide to atmospheric air, the oxygen and nitrogen percentages would fall, as shown by the following figures, based on air as 80.0% nitrogen and 20.0% oxygen.

CO_2 percent.	Resulting percentage in foul air	
	Nitrogen	Oxygen
1.0	79.2	19.8
2.0	78.4	19.6
3.0	77.6	19.4
5.0	76.0	19.0
8.0	73.6	18.4
10.0	72.0	18.0

Note that the decrease in N_2 percentage is quite marked, and where CO_2 percentages are over 5, it should not escape notice, even when fairly crude methods of analysis are used. Thus the figures given in the article are accurate enough to enable us to discount any theory which seeks to explain foul air as simply air plus CO_2. However the fact that we have analysis figures from only three areas altogether hardly allows us to come to valid positive conclusions.

Note C: Quite apart from any other considerations, it is not at all hard to believe that a cavern can evaporate several hundred times its own volume of water. We do not know whether the foul air in a cave has accumulated over one year, one thousand years or one million years. A cavern which has a steady water flow through it could quite easily evaporate such a quantity of water over a very long time, if it also has a small draught. So while we can rule out this as the main source of CO_2 we cannot rule it out as a contributor.

Note D: Proteins and other complex substances from animal and plant remains contain plenty of nitrogen. Whether or not decomposition ever proceeds to the point where this is released as the molecule N_2 is another matter. This question can also be raised concerning the reactions asserted in the article to take

place. These reactions assume the presence of plenty of oxygen, in fact enough for complete combustion of the organic material. One may be able to achieve this effect by lighting fires underground. The discussion of the processes by which the CO_2 is supposedly generated is far too superficial. What happens when decomposition is not complete, but only partial? Is the CO_2 produced to O_2 used ratio still less than one?

Note E:

If carbondioxide is generated at the expense of oxygen, then the nitrogen percentage will vary. Assume air to be 80.0% N_2 and 20.0% O_2. Then various values of the CO_2 produced to O_2 used ratio will give various resulting nitrogen percentages. The nitrogen percentage will also depend on the final CO_2 concentration. The following table gives resulting nitrogen concentrations for varying values of the ratio R for both 5% CO_2 and 10% CO_2.

	5%. CO_2	10%. CO_2
R	N_2 %	N_2 %
0.95	[illegible]	80,04
0.90	[illegible]	[illegible]
0.85	80,03	81,30
0.80	80.08	81.70
0.75	81.00	82.10
0.70	81.30	82.50
0.50	82.10	84.2
0.30	83.0	86.0

Applying in reverse the simple calculation used to construct the table, we can, given a foul air analysis and the local atmospheric analysis, deduce the average value of r operating in the carbon dioxide production process in that area. For example, from Denis T. Barnard's figures quoted in the article above, we get the value of R as 0.8. This calculation neglects the small percentage of CO_2 in the atmosphere, but this can easily be taken account of. It could be an experiment of value to take a sample of the soil near the Drum and to see at what rate it is producing CO_2 and using O_2. A similar experiment could be performed on samples of rubbish from inside the cave itself, such as bat dung and rotten sticks which abound there.

Note F:

The extent to which changes in barometric pressure can force gases into the rock walls of a cave or well depends entirely on the permeability to gases of the rock. This phenomenon has apparently been recorded, or at least deduced (see SUSS 1,3 where Haldane is said to have noticed that foul air in wells is present during periods of falling barometric pressure and absent during periods of rising pressure). Atmospheric pressure usually lies between 28 and 30 inches of mercury at sea level, i.e. varies about 10%. It is doubtful that this variation produces pressure gradients sufficient to drive gases into solid rock, or even to drive it very far into the cracks in the rock. A 10% pressure change induces a 10% volume change, and the volume of a crack in the rock is fairly small. The change in pressure would have some effect, though a small one, on the amount of carbon dioxide dissolved in any water in the immediate vicinity.

Note G:

Fyrite indicators are designed to measure the carbon dioxide content of flue gases which are usually between 20% and 100% CO_2. They claim to be accurate to 1%. The fact that they give readings which can be repeated (see SUSS 5,1), does not mean that the repeated result is the correct result. The indicators are in fact a scaled down version of the Haldane Gas Analysis Machine.

GEOPHYSICAL INVESTIGATIONS IN A CAVERNOUS LIMESTONE REGION

WARREN PECK.

About 16 miles south-east of the Northern Territory town of Katherine extremely cavernous Cambrian limestones occur, sometimes covered by up to 30 ft. of sandy soil. Durinf the later months of the "Dry" season, which lasts from April to November, the rock and soil layers above the water table are extremely dry. These conditions are unfavourable for any geophysical method requiring the passing of electric currents through the soil and rock layers, as with one or two exceptions rocks themselves are virtually non-conductors, and in fact it is their contained moisture that conducts most of the current. In the absence of moisture electrical resistivities are very high and difficult

to measure. In August 1961 the author carried out a reconnaissance geophysical survey in the area with a twofold aim:

1. To determine whether satisfactory results could be obtained by the electrical resistivity method under the adverse conditions.
2. To establish whether subsurface cavities can be located in this area by the electrical resistivity method.

The Electrical Resistivity Method of Subsurface Exploration.

This method makes use of the fact That different rocks have different electrical resistivities. By passing an electrical current into the ground between two electrodes and measuring the potential differences on the ground between two other electrodes, it is possible to obtain information on the electrical resistivity of the rocks through which the current is passing, and from this the nature of the rocks and the depths at which changes take place can usually be inferred. The Megger Earth Testing Apparatus is the most commonly used in this country.

The resistivity method may be used to make (1) resistivity depth probes at a selected point or (2) fixed depth resistivity measurements along a traverse line. In method (1) the electrode spacing is progressively increased to pick up changes in resistivity with depth. As the electrode separation increases the current penetrates to a greater depth, related to the electrode separation. This procedure has been figuratively called "electrical drillin". On the basis of the field measurements the resistivity depth curves are drawn on logarithmic graph paper, the resistivity in ohm-centimeters is plotted on the horizontal axis and the electrode separation in feet is plotted on the depth axis. Accurate interpretation is by comparison with standard curves from which both the apparent resistivity and depth of each layer can be derived.

In method (2) the four electrodes are kept at a constant spacing while they are moved along a line, and resistivity measurements are made at various stations. Lateral changes in resistivity of materials are indicated in contrast to the vertical changes obtained in method (1). The procedure in method (2) has been called, also figuratively "electrical trenching". Field measurements are plotted graphically, the stations are plotted on the horizontal axis, and the resistivity in ohm-centimeters is plotted on the vertical axis.

The Electrical Resistivity Survey South-East of Katherine.

The survey was carried out in four stages:

(1) To determine whether the method would give valid results, resistivity depth probes were made on the sites of the NTA Water Resources Branch No.1 and No.2 bores. The geophysical log was correllated with the drillers' borehole logs subsequently compiled when the bores were drilled, thus establishing whether the indicated subsurface structure actually agreed with that revealed by the borehole.

(2) Resistivity depth probes were made over a known cave to establish the type of anomaly to be expected from a subsurface cavity.

(3) In areas where the limestone was buried under the dry sandy soil, resistivity depth probes were made at intervals along a traverse line (chainages along this line in feet are indicated thus: E 14240).

(4) The boundaries of any subsurface anomaly revealed were then defined by resistivity constant depth traverses.

The Correlation of the Resistivity Logs with the Drilling Logs.

At Bore No.1 the resistivity log revealed all the rock types that the bore encountered and forecast the depth within 10% accuracy. The log revealed such minor features as a clay-filled cavity in the limestone between 58 and 62 feet and an open cavity in the limestone at a depth of 98 feet. Appendix A to this article compares the resistivity log with the drillers' records for Bore No.2. As with Bore No.1 an excellent correlation existed between the inferred structure and the structure revealed by drilling.

The Nature of the Anomaly given by a Cave.

It was realized that a cave would have a much higher resistivity than solid limestone, but no information was available as to the magnitude of such anomaly or the effect given by various orientations of the electrode line with respect to a long, narrow passage in the limestone. The cave selected for the tests was a vast system known as the Sixteen Mile Cave situated 16 miles south-east of Katherine. The author penetrated this cave for half a mile, while the

local cave explorers claim a penetration of 2 miles and state the cave continues beyond that point. Using a theodolite the centres of the depth probes were positioned vertically above a passage with an average width of 12 feet. The first depth probe (see Appendix B) was aligned at right angles to the passage and sited where the limestone outcropped. The second depth probe (see Appendix C) was aligned parallel to the passage and sited on clay soil. For comparison purposes in both appendices the known structure is plotted alongside the resistivity curve. Both depth probes clearly revealed a cave, but only that aligned a right angles to the passage clearly revealed the depth of the cave.

Location of Caves where the Limestone is Covered by Overburden.

Two miles north of the Sixteen Mile Cave the flat-lying Cambrian limestone is overlain by over 20 feet of soft Cretaceous sediments which have weathered to a sandy soil. In this area resistivity depth probes were made at arbitrarily selected points along a traverse line and any revealed anomalies were defined by constant depth traverses. Two anomalies were detected.

The first was initially detected by a depth probe at £ 14,000 (see Appendix D). The anomalous high resistivities revealed below 30 feet are of the same order as those given by the cave as illustrated in Appendices B and C. A depth probe aligned at right angles to that of Appendix D gave similar results, suggesting the feature is not a narrow tunnel. Nearby at £ 13,850 is a circular depression 60 feet across similar to the sinkhole on the Playing Fields at Jeralan. A constant depth traverse with an electrode separation of 60 feet shows a marked anomaly over the sinkhole not inconsistent with a recently collapsed cave roof. The graph of this traverse is Appendix E. On either side of the sinkhole the graph reveals marked high anomalies which could easily prove to be caves. Further traverses revealed that the anomaly trended north-south and heads firstly for two sinkholes one mile south and secondly for the entrance of the Sixteen Mile Cave another mile south. The fact that the Sixteen Mile Cave heads north makes it quite a possibility that this first anomaly is the Sixteen Mile Cave. An exploratory drillhole was sunk 400 feet north of £ 14,000 and discovered an apparently collapsed cave filled with sand to a depth of 64 feet. Perhaps the traverse line encountered the northernmost known extension of the Sixteen Mile Cave.

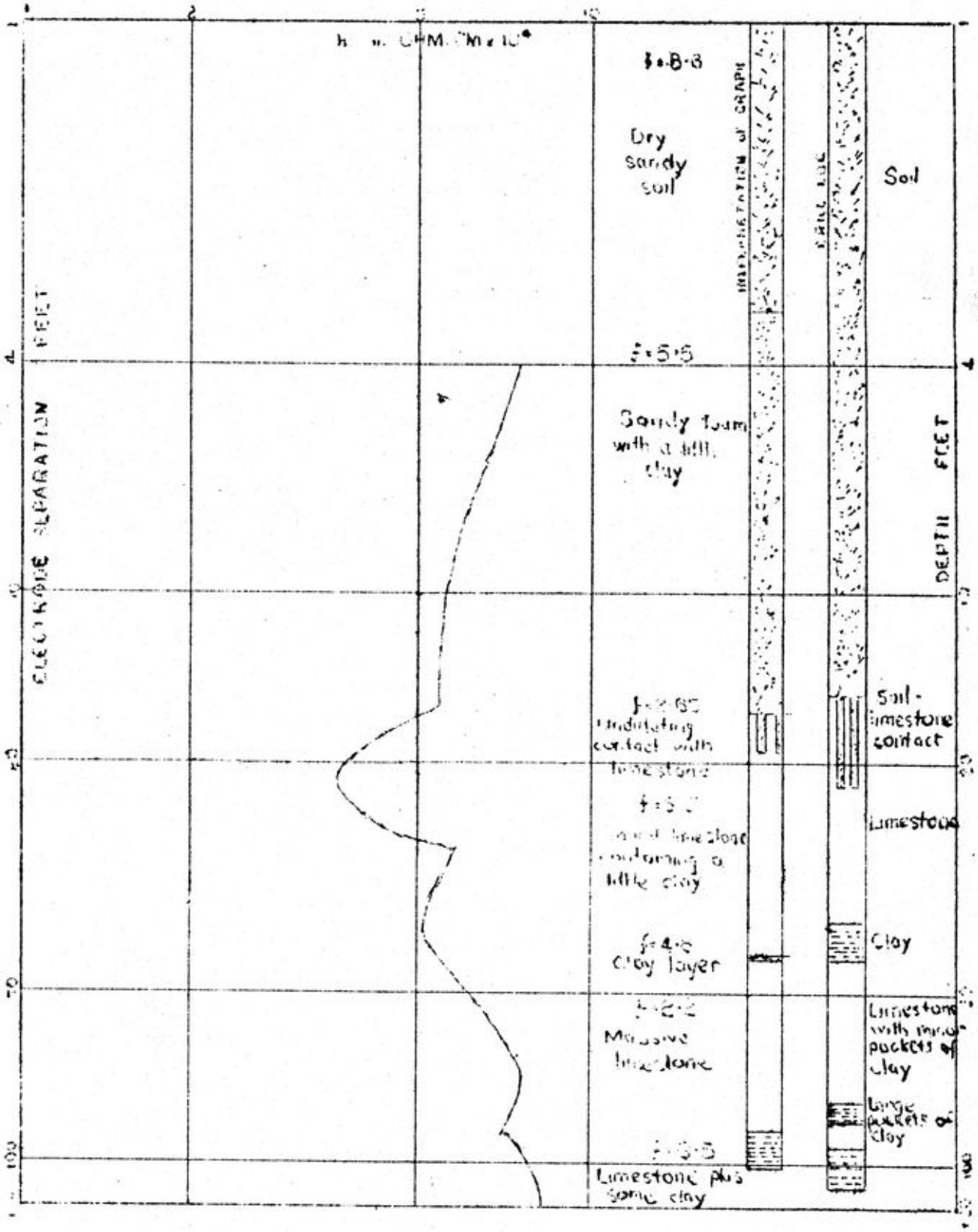
The second anomaly at £ 10,000 was detected by the depth probe whose curve appears in Appendix D. As no time was available to define the limits of the anomalous low value between 34 feet and 42 feet in depth, it is not possible

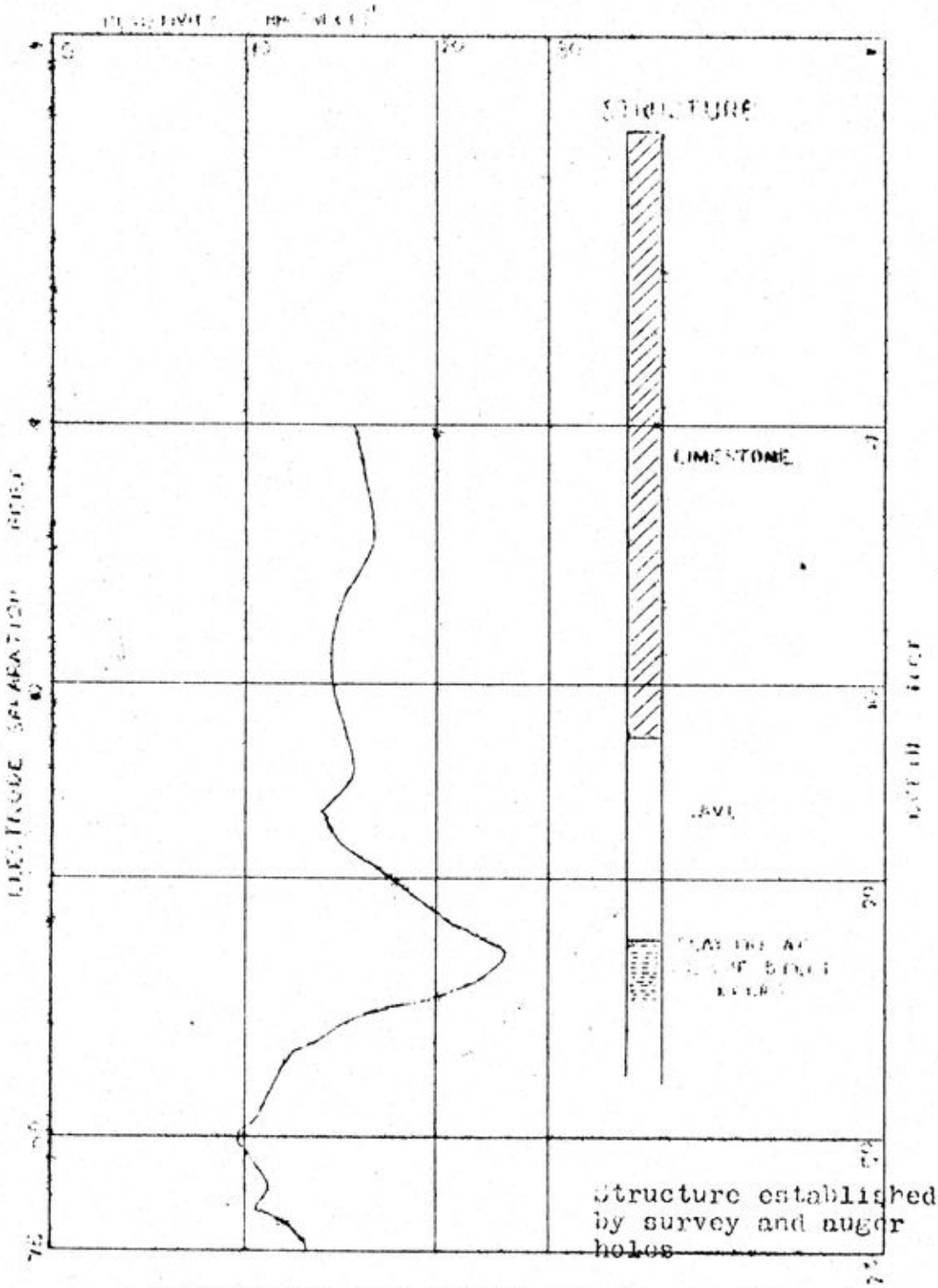
to ascribe it with any certainty to a particular circumstance. However the resistivity of the material at this depth is similar to that of the sandy clay fill that floors the Sixteen Mile Cave, and it is possible that this anomalous low might be a cave almost filled with sandy clay. If this is the case then the sharp upturn at electrode separation 30 feet may represent an air space above the clay fill.

Conclusions.

The geophysical investigations determined that satisfactory results could be obtained with the electrical resistivity method in a cavernous limestone region under somewhat adverse conditions. Therefore extremely well-marked anomalies should be obtained over caves in areas such as Jenolan, Yarrangobilly and Buchan where the greater moisture content of the rocks will give lower resistivities than those observed above. However in areas of steeply dipping beds, such as Jenolan, the electrodes for a depth probe should be aligned parallel to the strike of the beds to minimize the influence of the variation of electrical properties from layer to layer in a thick limestone unit. The interpretation of the resistivity curves obtained in a limestone region is not easy, and the novice is warned that an anomalous high value should only be called a cave once all other geological possibilities have been ruled out by careful and intelligent investigation.

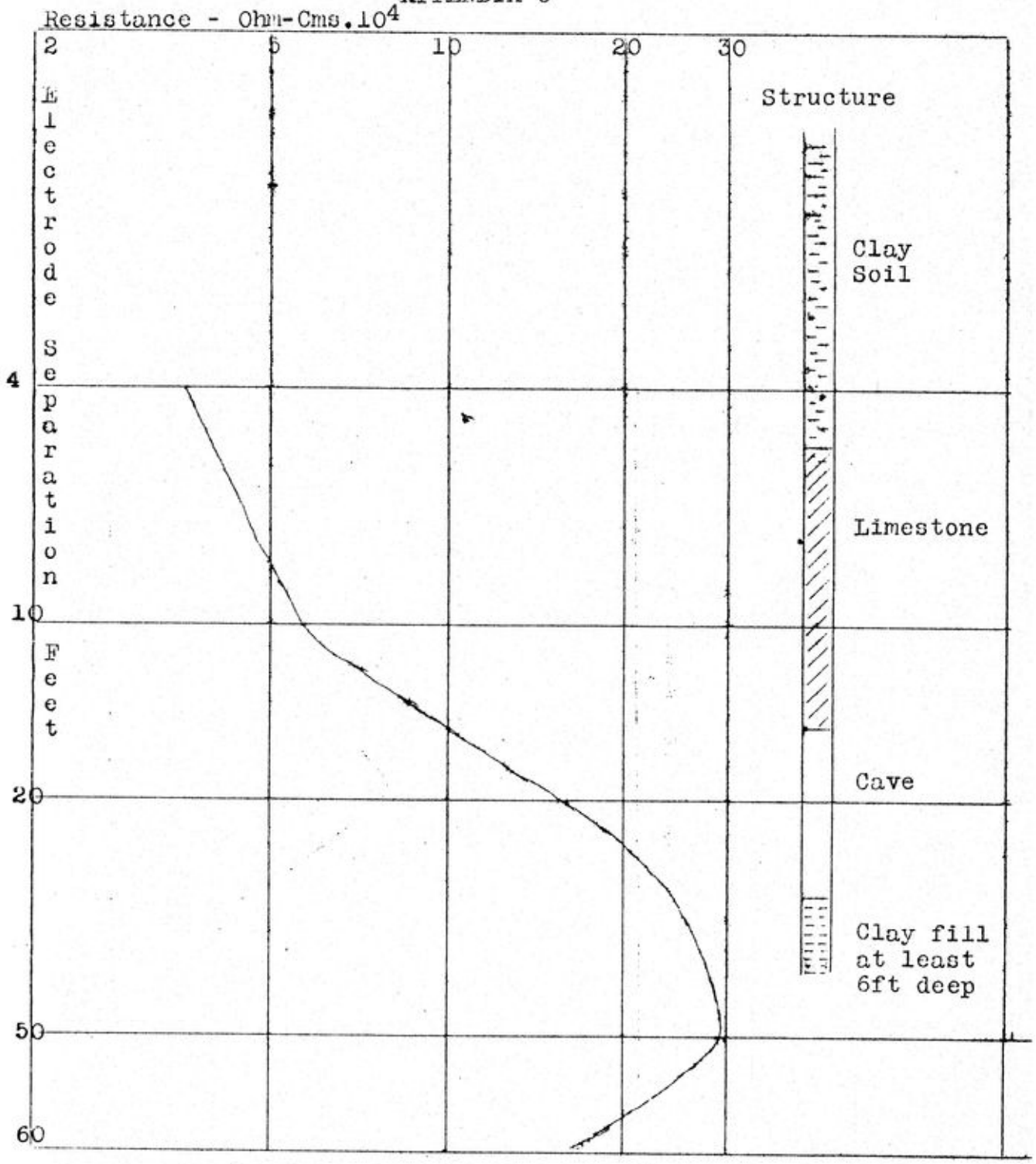
APPENDIX A


ELECTRODE SEPARATION
FEET
DEPTH FEET
Dry sandy soil
Sandy loam with a little clay
Soil
Soil - limestone contact
Limestone
Clay
Limestone with small pockets of clay
Large pockets of clay
Limestone plus some clay



Depth probe over the 16 mile Cave - line of probe at right angles to cave passage

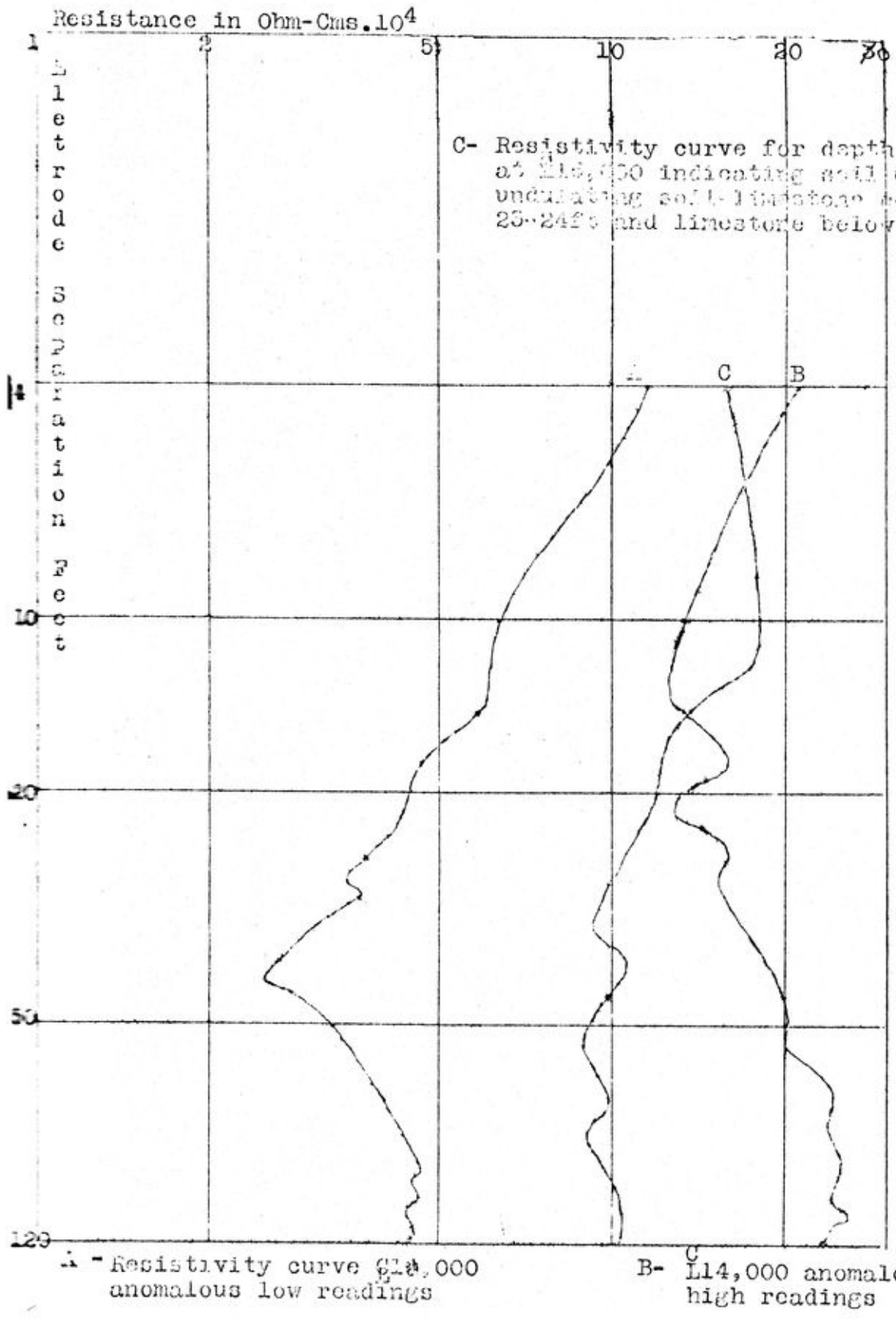
APPENDIX C

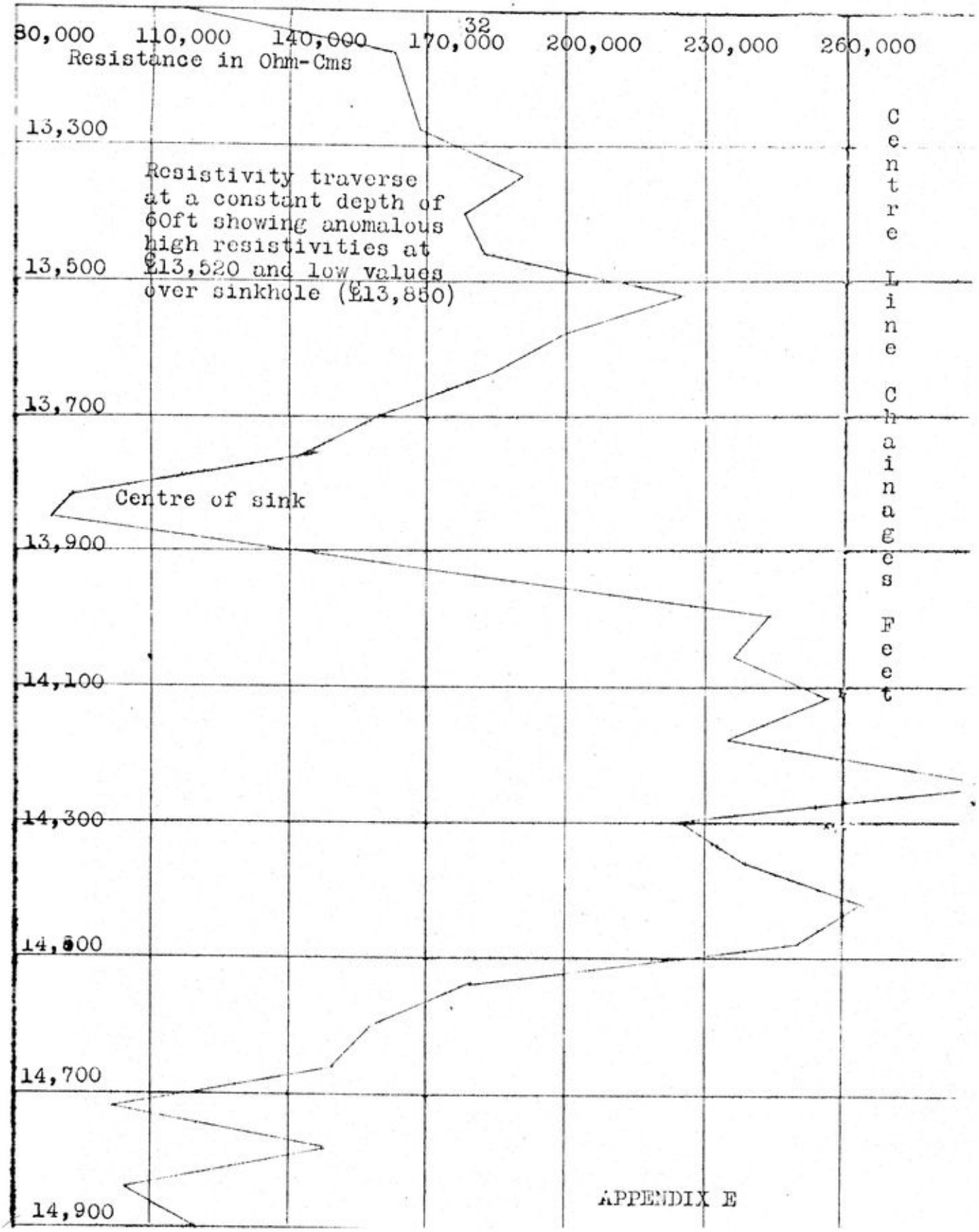


Depth Probe over the 16 mile Cave - Line of Probe parallel to elongation of Cave Passage

Structure established by survey & auger holes

APPENDIX D


Resistance in Ohm-Cms.10⁴
1
2
5
10
20
30
Electrode Separation Feet
1
10
20
50
120
A
C
B
C- Resistivity curve for depth probe at L14,000 indicating soil 0-23ft underlying soil-limestone contact 23-24ft and limestone below 34ft
A - Resistivity curve L14,000 anomalous low readings
B- L14,000 anomalous high readings


80,000
110,000
140,000
170,000
200,000
230,000
260,000
Resistance in Ohm-Cms
13,300
13,500
13,700
13,900
14,100
14,300
14,500
14,700
14,900
Resistivity traverse at a constant depth of 60ft showing anomalous high resistivities at £13,520 and low values over sinkhole (£13,850)
Centre of sink
Centre Line Chainages Feet

APPENDIX E

an active and skilful photographer, a stalwart of SUSS Productions a walkie-talkie enthusiast.

In his later days in SUSS Ted was concerned more and more with his medical duties, and, as befitted a professional man, the crazier schemes of youth gave way to a maturer responsibility, but he still found time to devote to the society. Elected to the Committee for the first time in 1961, he was active in photography and on the blasting sub-committee, and conceived the idea of organized tetanus injections for members.

To convey some idea of what Ted was like would require more words than this, but while there are still people travelling to Jenolan with seven packed into a hired car with no gears, while there are still people to swim in the Blue Lake at midnight or the Lett River in midwinter, while, finally there are people always looking for new places to get into and new ways of getting into them, Ted will not be forgotten.

ROSS FRASER

Strange to tell, Ross Fraser, otherwise known as Bacchus, had to be persuaded to come on his first caving trip. It was a SUSS expedition to Cliefden, and with his tall but frail frame he looked anything but a cave-crawler. That he found something in SUSS he had not expected to find is obvious, because after his first trip he became devoted to the society and to the people in it. It was not the caving that first appealed to him but the companionship he found, companionship based on equality.

If his clothes were a little ordinary andhe treated them carelessly this was acceptable, perhaps even expected. Nobody in SUSS cared that he wasphysically weak; that he was strongly individual was enough. Never one to copy the mannerisms or thoughts of others, he combined an airy bravado, a reckless enjoyment of life, with a distinctive way of speaking and arting. He had his slant on life, andtthis inclined him to stick with SUSS.

All these characteristics emerged in his second caving trip, to Colong in March 1958. His driving, which he enjoyed immensely, caused his passengers some anxiety - "Baron von Fraser" he called himself. On the walk into Colong he fell behind the party when he stopped to don some more protective clothing, and became lost. He was found a few hours later, soaking wet but still cheerful, trudging up the creekbed. As a result of

became seriously ill and decided to take caving a bit more easily.

Ill health in fact influenced Ross's whole career. Forced by it to give up a pharmacy course he took up accountancy under doctor's orders not to overwork himself at exams. He never complained, but settled down quite happily in his new job where he could take the study at the pace his health imposed. It was now that he began to show a real and obvious pleasure in caving, even though his ventures were to some degree limited by his physical condition. He made much of his "ruggedness", but his boasting only acclaimed the deeds of others, never his own.

It was clear that he could not always live in the dream world of daring and rugged exploits when his limitations were what they were, and he became a person who always carefully considered the next step. One aspect of this perhaps was his aloofness in Society politics, and there were plenty of politics in his time. He remained a prospective member for almost three years, depriving himself of a vote but speaking at meetings with a considered reason and a moderation that characterized all his contacts with other people and threw an all too brief light of sanity on the furious fanatics and many zealots clashing in their sulphurous canopies around him.

Of late the change was more evident: he began to appear at meetings in a suit and his old habits seemed to have been discarded along with the rimless glasses. He bought himself a vote in the Society by becoming an associate member, and turned his energies to SUSS Productions, where his by now considerable accounting knowhow fitted him ideally for the job of financial wizard and policymaker, in a field where the majority of members cared nothing and knew less.

That the loss of Bacchus will be practically felt by SUSS now and in future is undoubted, but it is the loss which is harder to define that will also be harder to forget. Those who remember the crazy campfire monologues, or the sudden appearance of his deprecatingly rakish figure on a trip or at a meeting and the cry of "There's Bacchus!" will not forget him. Those who came too late will miss him without knowing what they miss.

> Alas, that Spring should vanish with th rose,
> That Youth's sweet-scented manuscript should close-
> The nightingale that in the branches sang,
> Ah, whence and whither flown again, who knows?
