CHILLLAGOE CAVES FAUNAL CHALLENGES

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ABSTRACT

A review is made of early biologic studies at Chillagoe. The precise meaning of Chillagoe as a site of study is indicated. The danger of high carbon dioxide levels in certain Undara lava caves is evaluated. Current studies are briefly described and summarized. The peculiar environment milieu of Chillagoe is an ideal site for studies of evolution of cave life and cavernicolous adaptation. Finally, a research facility is proposed as essential for continuing significant research.

EARLY STUDIES

The first humans to become aware of the fauna of Chillagoe Caves could have been members of the aboriginal Ojanken and Wakamen tribes since their territorial boundaries are believed to have existed east of Chillagoe. It is not improbable they would have entered the larger caves seeking reptiles, fruit bats, wallaroos, *(Macropus robostus)* Wallabies *(Petrogale sp.)* and other smaller mammals peculiar to their diet. In the Walkunder Arch Cave, where occupation has been dated at older than 18,000 B.P. wallaby bones and a portion of a Diprotodon molar have been found at the lowest level. The probability of these organisms coming from some of the caves in Walkunder Tower is remote, but demonstrates the proximity of living sites to caves. The Children's Python *Liasis childreni,* a common reptilian inhabitant of the Chillagoe Caves is believed to have been a common component of aboriginal diets.

Hence we can, in a sense, indicate that the fauna of Chillagoe Caves have been objects of interest since the Pleistocene times. Early histories are a bit imprecise, but modern humans were aware of the Chillagoe Caves by 1881, and copper was being mined on a commercial basis by 1890. As is well known, several thousand humans resided in the Chillagoe-Mungana metropolitan area by 1908. Given the mining background of many of these inhabitants and the difficulty of transportation, it is probable that caves close to town were frequently visited and the more astute visitors would have noted some of the prominent species. By 1920 six species of bats had at least been recorded as occurring at Chillagoe. *Miniopterus schreibersii*, the common bent-wing bat; *Miniopterus australs*, little bent-wing bat; *Eptesicus pumilus,* little brown bat; *Rhinolophus megaphyllus*, Eastern horse-shoe bat; *Taphozous georgianus,* sheath tailed bat; and *Hipposideros diadema*, large diadem horseshoe bat. Also, the Northern Grey Swiftlet, *Aerodramus spodiopygius chillagoensis* would have been noted since caves in the Tower of London represent only one of the few known roosting sites.

Both the macro- and micro invertebrate fauna remained unnoted scientifically until recently, notwithstanding all the visitation of the caves. The Sydney Speleological Society visited the Chillagoe area in January, 1966 and August, 1967 and published a list of fauna collected, mainly by means of light trapping (Anon, 1969). A troglobitic Blattellid and a troglobitic Staphylinoid were reported.

CHILLAGOE-GEOGRAPHIC DEFINITION

Before detailing more recent studies it is necessary to specify what is precisely meant by the term "Chillagoe". In a sense it has become almost a generic term for caves in a large geographic area of the Cape York Peninsula, North Queensland, Australia. The remoteness of the area to all but those intimately acquainted with its geologic diversity has resulted in the term "Chillagoe" being applied rather loosely to three discrete geographic areas. I find that those investigating this area tend to overlook this discreteness which results in confusion to others less intimately familiar with the distinctive geomorphology of Chillagoe.

Originally, **Chillagoe karst** was applied to a series of pinnacled towers which project up to 80 m above the surrounding plain in a belt of limestone 5 km wide and 50 km long extending from South of Chillagoe to North of the Walsh River. This belt is some 200 km West of Cairns. The limestone, Silurian in age, has undergone extensive uplift and erosion in the late Cenozoic resulting in dozens of these highly dissected towers looming up above ground level concentrated around Chillagoe, Mungana and Rookwood, (Ford, 1978). A rather simplistic explanation is that the heavy summer precipitation results in sharp, narrow grooves, Rillenkarren, developing along these sometimes massive towers. Investigators of this karst terrain are acutely aware of the sharp edged grooves in the limestone that can readily lacerate skin, clothes and even heavy boots. Occasionally flat shallow pans, kamenitzas, occur on level plots of the karst. Deep, vertical flutes scour many of the cliff faces. Finally, grikes, which are larger and deeper indentations, are to be found in many towers. These grikes may give access to some of the caves to be found in the towers.

Some caves, usually smaller and lacking significant vertical relief, are to be found in low lying extensions of the Chillagoe karst outside the zone of tower karst. Several of these, for example, Tea Tree Cave, have significant paleontological deposits.

Approximately 120 km NW of the belt of Chillagoe karst is the **Mitchell-Palmer karst** on Mt. Mulgrave and Palmerville Stations. This limestone is virtually inaccessible during the rainy season and not overwhelmingly inaccessible even in good weather. For all practical purposes there is only one poorly maintained track passing near the Mitchell-Palmer limestone. Here caves are found in towers up to 200 m high. The towers tend to be more massive than those closer to Chillagoe. Being more isolated they hold a greater potential for biologic diversity. There have been only three serious faunal collecting trips to the Mt. Mulgrave sector of Mitchell-Palmer area and none for more than a few days. Although frequently included as "Chillagoe" caves in references, there is some uncertainty as to whether they developed contemporaneously with caves at Chillagoe. (Pearson, 1982).

Some 130 km South of Chillagoe are a series of **lava tubes** formed in the **Undara** lava flow. This is an extensive flow, over 160 km in length, much younger geologically than the Chillagoe karst. It has been dated as late Pleistocene with an approximate age of 190,000 years. (Atkinson, Griffin and Stephenson, 1976). Three caves, Bayliss, Pinwill's and Nasty have been studied on three of the previous expeditions (Sullivan 1984). Much to the surprise of all concerned, one of these caves, Bayliss, has yielded 51 species of terrestrial arthropods of which forty three are troglobites (Howarth 1987). Howarth and Stone will be reporting on this biota during this conference. Two constrictions in Bayliss trap the cave atmosphere into three zones. The inner zone has a downward sloping floor that acts as a trap for CO_2. It is assumed that the CO_2 is biogenically generated.

HAZARD OF HIGH CO_2 CONCENTRATIONS

An unanticipated hazard to studies of the cave fauna in the Undara lava is this abnormally high concentration of CO_2. This phenomenon is also referred to as foul air, and the terms have come to be used interchangeably in the literature. (James, Pavey and Rogers, 1975). Foul air can also denote the presence of NH_3 in caves rich in bat guano and H_2S from decaying organisms. Australian cavers have known of high concentrations of CO_2 in Grill Cave at Bungonia as early as 1931, which eventually caused the closure of this cave (Nurse, 1972). James (1977) reported specifically on the presence of higher than normal CO_2 concentrations in Bungonia. In 1984 we used a Draeger Multigas Detector to test for a number of gases in Bayliss Caves and obtained readings approaching 5% CO_2 concentrations. The accuracy of this technique depends on the tubes used. Normally, a 0.1% CO_2 concentration is tolerable. But at a 3% concentration in the inspired air, there is an increase in the rate and depth of respiration. One subjected to such a concentration suffers a measurably diminished capacity for physical work and exhibits befuddlement. At 4% CO_2 concentration the rate of ventilation triples; nausea, sweating and a throbbing headache can occur. If one can survive a 5% CO_2 concentration there is an "off effect" in which respiratory problems persist even after leaving the cave. Obviously, rescuing an individual in a high CO_2 environment is a danger to the rescuers themselves.

It is not clear if the high CO_2 concentration is constant or seasonal. There may be seasonal variations in the amount present depending on air movements and on rainfall, so that measurements need to be taken on an annual basis (Wigley and Brown, 1976). High CO_2 concentrations have been reported from Gaden-Coral Cave, a part of the Wellington Cave complex (Armstrong and Osbourne, 1981). In passing, it should be noted that the concentrations of 12%-13.5% CO_2 reported from Molong and Wellington Caves (Frazer,1958) are not endogenous to the cave. Probably this was an exogenous source, possibly due to flooding through porous sediment.

SUBTERRANEAN ENVIRONMENTAL IMPLICATIONS

Thus, in the Chillagoe area there are several widely diverse subterranean environments worthy of study. The Australian Karst Index contains listings of over 500 caves in the Chillagoe area (Matthews, 1985). Many members of the Chillagoe Caving Club believe this is but a small percentage of the total number. To say that there is a great potential for caves in and around Chillagoe ranks as a classic understatement. The remoteness of the Chillagoe area has resulted in little human disturbance of the cave environment. The limestone towers vary in distance from 0.5 km to 3 km from each other. Thus, no caves in one tower connect with those in another, although caves in any given tower may extend to the water table in the phreatic zone. For terrestrial organisms each system of caves within a tower constitutes a geographically isolated area; hence the populations of cave organisms are also isolated. This presents an ideal opportunity to study the rate of evolution of cave life manifested by different but related species and the mechanisms of adaptation to a cavernicolous environment. In addition, each cave may be different geomorphologically, environmentally and biotically. Within each tower can be found a suite of differing cave types with similar suites of cave types to be found in other towers.

In effect, each tower or assemblage of towers can be viewed as an island with their faunas having developed in isolation giving the opportunity for significant comparative research on evolutionary and ecological processes. (Barr, 1968; Howarth, 1980). It is possible to conduct detailed ecological studies in an analog cave of similar features which is isolated from the first cave. It is also possible to study animal distribution and exploitation in the suite of caves in one tower; then study analog caves in other towers which differ in one or but a few of the biotic or abiotic factors being examined. This approaches as ideal a situation as is possible in ecological studies for having an experimental control. The large number of caves with fig tree roots reaching down into deep cave zone passages establishes a whole new source of energy input and needs continuing study.

Several preliminary lists of material collected at Chillagoe have already been published. (Matts, 1987; Hoch and Howarth, in press). This symposium will feature reports from Stone, Howarth, Hoch and Asche which will complement earlier investigations. We are, in a way, suffering from an embarrassment of riches. The backlog of undescribed organisms increases annually, notwithstanding the efforts of numerous invertebrate taxonomists to reduce this backlog. And it seems that each year a dozen or more new caves are located, none of which have been investigated for their biologic potential. Just recently a 500 metre extension of Bayliss Cave has been discovered by the Chillagoe Caving Club. The ever widening wave of investigations into the Mitchell-Palmer and Undara areas reinforce the richness of faunal diversity indicated by the term Chillagoe.

FUTURE PLANS

What next? Before our logistical lines of support get totally out of hand, it is essential to establish a research center in Chillagoe to store and maintain the equipment critical for on going biological investigations. Also, laboratories in which organisms can be studied in a sedate environment are urgently needed. Microscopic analysis; photographic studies; storage of comparison species; taxonomic and morphologic reference works should all ideally be available to be utilized on site. If one measures the great distances many investigators at Chillagoe must traverse before having a suitable arena for study, then our expeditions have an extremely low efficiency rating. We desperately need a modern, well equipped, functional laboratory where the rapidly escalating collections of specimens can be evaluated and stored for future reference. With transportation to Chillagoe improving, investigators can more readily visit Chillagoe and its caves. The incipient publications referred to today will focus even more attention to the distinctive and impressive fauna of Chillagoe. Fifty years ago Chillagoe was a center of great mining import. It is pleasurable to contemplate that today Chillagoe is now evolving into a center of biological research.

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