THE RAFFLES BULLETIN OF ZOOLOGY 1998 46(1): 1-10

PERSPECTIVE

FAUNAL COLLECTING IN SOUTHEAST ASIA: FUNDAMENTAL NEED OR BLOOD SPORT?

Robert B. Stuebing
Research Associate, Division of Amphibians and Reptiles, Field Museum of Natural History, Roosevelt Road at Lake Shore Drive, Chicago, IL 60605-2496, U.S.A.

INTRODUCTION

In the mid-1980's, while lecturing at a small university in Sabah, I accompanied my honours student to the Danum Valley Field Centre for fieldwork, an inventory of small mammals near the Danum station. The university was training students in field biology, while acquiring mammal specimens for the university's small museum, sponsored by Danum Valley Management Committee. The station had been open less than a year, with only a few researchers working on site. One evening after dinner I was approached by a European visitor to the station, who inquired about our work. When I replied that we were collecting small mammals as part of a faunal inventory, he gazed at me with great concern and remarked, "Don't you think what you are doing is contradictory to the status of Danum as a conservation area?" Although our subsequent discussion was brief, both of us quickly realised our points of view were rather different. The experience has remained with me ever since.

I have worked in Malaysia for the past 25 years lecturing in animal taxonomy and ecology, and conducting field studies of frogs, snakes, crocodiles, birds and small mammals. Since the early 1970s there have been some dramatic educational, demographic and environmental changes in the country, as the development of plantation crops progressively expanded, and formerly extensive forests rapidly receded. Agricultural, agroforestry or aquaculture schemes became popular alternatives to the management of original habitats. In tertiary education, taxonomy and ecology gradually took a back seat, as it had in temperate countries, to applied sciences and biotechnology. Rather abruptly in the 1990s, the subject of threatened biodiversity entered the stage, with its emphasis of documenting species of the tropics, where diversity is greatest. A great urgency was felt to sample this largely unknown resource before pristine habitats disappeared. Funds have become available, but efforts to document Malaysia's biodiversity have, unfortunately, not kept pace with rapid agricultural and industrial growth, which has progressively altered the landscape. In fact, collections of terrestrial vertebrate specimens has declined almost to zero. This paper attempts to explain how collections have run aground, and with luck, how they can be put back on track.

Received 3 Jul 1997 Accepted 30 Sep 1997

HISTORICAL INFLUENCES ON LOCAL FAUNAL COLLECTIONS

The decline of Malaysian faunal collections had begun by the early 1970s, and occurred at the same time that university curricula drifted away from systematics, taxonomy and ecology courses. In addition, national and state museums, repositories of natural history collections from the colonial period, began to view themselves more as custodians of historical and cultural, rather than biological collections. The concept of museums as centres for research, also gave way to the outlook of a museum primarily as a place of exhibition. For example, the famed Raffles Museum, later the National Museum of Singapore, and repository of some of the most significant collections of Southeast Asian fauna in the world, suffered a serious, unsettling policy change in the early 1970s. The authorities at that time abruptly decided that the museum should focus exclusively on non-scientific areas such as art, culture and history, and that the zoological collections should be removed, given away to interested parties, or even thrown away if there were no takers. Only through a mixture of luck, and the foresight of several local zoologists did the collections survive essentially intact, to become today's Zoological Reference Collection at the National University. Interestingly, herbaria associated with local Forestry Departments (linked with an economic validity, so to speak), continued to flourish. Impetus for documentation of the flora of Malaysia remained, leading to the development of new facilities and training of a new generation of botanists and their assistants. In most cases, however, faunal collections were virtually forgotten, except by the small group of scientists who required specimens for their work, and were forced to follow specimens that were shifted from one storage site to the next as museum priorities changed. The collections themselves became static exhibits of marginal scientific importance and taxonomic research declined, along with the numbers of staff trained to conduct it. Most local museum specimens are now very old, have no field data and/or have deteriorated considerably. The state of faunal biodiversity collections are in urgent need of review. It is also time to renew and enhance collecting efforts, since the time for many natural habitats is running out, and can now be measured not in decades, but years, or sometimes even months. Efforts to restore this great resource to museums, and to Southeast Asia must no longer be thwarted or delayed.

FAUNAL COLLECTIONS AND CONSERVATION

For about a decade, the international conservation community emphasised the enormous value of biological diversity, particularly that found in the tropics. Despite bearing an element of truth, this assertion implied that the value was not only scientifically significant, but guaranteed important financial rewards. This "economic value" approach, initially so successful for conservationists, has serious damaged local and international efforts to document the very biodiversity it seeks to save. Politicians, supported by civil servants, have used these assertions of huge economic potential as a basis for passage of restrictive legislation to ensure against theft. This situation now applies almost every country in the world.

Although the good intentions of faunal protection laws are undoubtedly genuine, such regulations tend to impede scientific collecting. Strict regulations can perhaps curb irresponsible actions by a handful of scientists, but penalise the great majoriy of responsible ones. As the weakest of all interest groups involved in biodiversity pursuits, scientists become the first casualties of such regulations, even though so few have any interest in commercially valuable or truly endangered species (Campbell and Frost, 1993).

We should avoid curtailment and denial of scientific collecting which causes no harm, but in fact benefits both the natural world and society (Winker, 1996). New discoveries based on specimens " not only contribute to the inventory of biological diversity, but allow current theories about the evolution of form and function to be tested" (Lauder et al., 1995).

Collections of terrestrial fauna have in fact contributed immensely towards the cause of conservation, in the form of field guides and the knowledge of species and ecosystems. It is an unappreciated fact that all field guides published on the Malaysian fauna to date, have been based almost exclusively on museum specimens (Harrison, 1964; Inger and Stuebing, 1997; King, et al., 1975; MacKinnon and Phillipps, 1993; Medway, 1977; Medway, 1978; Payne, et al., 1985; Smythies, 1960; Tweedie, 1983). This does not include numerous volumes on fish, crabs, butterflies and a multitude of other groups. Beyond the importance of specimen collections to field guides, the enforcement of CITES (Convention on the International Trade in Endangered Species) regulations also requires the support of museum specialists and their collections for accurate information on species.

THE NEED FOR FAUNAL SPECIMENS IN RESEARCH

Field studies

The benefits of systematic sampling of faunal communities goes far beyond describing characteristics of a particular species in the field. Specimens represent an invaluable permanent record of communities, their structure and natural variation (Leh, 1996). Information obtained on taxonomic, geographic, anatomical, biochemical and phylogenetics of species, are undeniably superior when compared to a brief field note (based on a fleeting glimpse), or a two dimensional photograph. Popular media productions may give the impression that what needs to be known can be obtained in a few months filming. Field observations in themselves are important, but in virtually all instances are never sufficient if no specimens are obtained. An unfortunate example from ornithology is the recent description of a new species of shrike from Somalia (Smith et al., 1991). The bird was released after a few feathers and a tissue sample was taken, and has not been seen since. Without a specimen, an adequate understanding of the taxonomic status of the species is now impossible, unless the bird is caught again in the future.

Molecular techniques

It is said that specimen collecting is now redundant because of powerful, precise molecular techniques, requiring only a tiny bit of tissue from an individual animal. Molecular techniques have undoubtedly brought tremendous progress in taxonomy and systematics, but these new tools must be put in proper perspective. Species are defined from DNA or tissue only in a very abstract sense. As the fundamental unit of an ecological community, they possess a tremendous variety of characteristics to be researched, not only their DNA. Information on such adaptive features as comparative morphology and anatomy, or embryology is obviously unavailable from DNA comparisons. The identification of venomous and pest species, or disease vectors cannot be ascertained by studying DNA. Not surprisingly then, our most basic research needs cannot met by limiting collecting to tissue fragments. Nevertheless, frozen tissues from the internal organs of dead animals can, even years later, help to unravel medical mysteries such as the epidemiology of deadly viruses (Dessauer and Hafner, 1984).

The frightening truth is our knowledge remains severely limited. Field biologists work slowly because they must supply full documentation such as field data, fixation and ensure proper preservation of every specimen they acquire. The specimens provide a permanent record of identity, distribution and habitat requirements for comparison with the past and understanding the future. Environmental impact assessments rely heavily on such information, yet for how many species is the information available from local institutions?

Beyond the tangible scientific data, invaluable experience is gained from the collecting process itself. Contact with each species leads to new insights or discoveries, some arising many years after the fieldwork. Charles Darwin's experiences as a naturalist and a collector on the *H.M.S. Beagle* took decades to bear fruit. The value of well-managed, representative and properly documented collections cannot be under emphasised. A basic example is the slender litter frog, *Leptolalax gracilis*, was first collected near Matang in Sarawak and described by Mocquard more than 100 years ago. It was regarded as a single species until the mid-1980s, when additional amphibian collections revealed there were actually five species of *Leptolalax* in Borneo (Inger & Stuebing, 1997). Beyond strictly scientific progress, Savage (1995), has remarked that the discovery of new life forms and studies of their attributes frequently leads to major economic, health or environmental benefits.

Unfortunately, there is now opposition towards killing animals for any purpose, scientific research included. Proponents assert that specimen collecting adds to the current "biological holocaust", and suggest that collectors pose a serious threat to many species. Because of high mortality and local extinctions, collection of fish for the aquarium trade has been condemned, even in species which die by the millions during the dry season (Ng & Tan, 1997). Field biologists who make routine acquisitions of specimens may also depicted as putting species in danger of extinction. This view invites the confusion of biological with other kinds of collections. For stamps, coins or fine antique china, high value must certainly be placed on rarity, while rarity in fact holds no special virtue to a taxonomist or ecologist. Neither commonness nor rarity contributes to the scientific value of a specimen; its real value lies in the depiction of the population from which it was taken (Williams, 1994). A field biologist seek to species in space and time, a goal best served by those which are abundant enough to allow natural variation to be understood. Researchers do not seek to harm species already threatened or endangered. Ironically, it has only been through collections that information on species is even available, and that declines have been noticed (Shaffer, et al., 1998). In contrast, bulldozers, chainsaws and fire have escaped criticism in this regard.

It has also been asserted that new collections are unnecessary since existing ones are sufficient for any present or future studies. In fact, from both a taxonomic and a geographical perspective, existing collections are most certainly not adequate. Substantial numbers of species are represented by *one or only a few individuals*. Goodman & Lanyon (1994) estimated that there are 6,000,000 - 9,000,000 bird specimens worldwide, in museums. This means that there are about 1,000 specimens per species (fewer for tropical birds), all collected over 150 years, for an average of about 6.6 specimens per species per year. It is estimated that subspecies with ranges about the size of Great Britain are represented by one specimen per 1,000 km^2 of habitat, which is about one and one-half bird specimens per species for an area the size of Sarawak's Lanjak-Entimau Wildlife Sanctuary (167,000 ha). An average patch of 100 hectares of tropical forest in the Amazon supports an estimated 1,800 individual birds One hundred hectares is also the current estimate of the average area of tropical forest destroyed every hour (Goodman & Lanyon, 1994).

How much do we already know? Very little, actually. Sabah Museum vertebrate collections represent less than 50% of the State's vertebrate fauna, and many species are in fact represented by a single individual. Of the Sabah faunal collections held outside the country, more than 50% of the vertebrate specimens are from one locality, Mt. Kinabalu. The Sarawak Museum has a greater volume of total specimens, but many are from the colonial era, e.g., pre-1963. This is a problem facing faunal collections worldwide, the majority of which are from 40-120 years old. The average collecting date for a bird specimens held by the three largest museums in the United States (The U.S. National Museum/ Smithsonian, Field Museum in Chicago, and the Academy of Natural Sciences, Philadelphia) is 1928. The old material frequently lacks field data except for locality and date (Winker, 1996). All of the above remarks refer to vertebrate species, which are relatively well known. The challenges facing invertebrate collections (with about 5-100 million still waiting to be described), are much the same, but of considerably greater magnitude. Fortunately, few objections are raised to the collecting of invertebrates.

Beyond age, there is the problem of specimen distribution. Faunal collections worldwide are not evenly distributed. For example, no group of vertebrates from Malaysia can be adequately studied (in the basics of biodiversity, e.g., taxonomy and systematics) within the country for reasons of insufficient numbers, poor quality or date of acquisition. This situation holds true for most ASEAN countries, certainly for Malaysia, Indonesia, Brunei and the Philippines and probably for all the others except for Singapore. Yet, for a variety of reasons, from taxonomy and medical ecology to environmental impact assessments, a local systematist will still be required to be "an authority on all organisms of a given group" (Davis, 1995). How will this be done in the species-rich, but collection-poor tropics? The study of vertebrate embryos of is tremendous utility in biology and yet embryonic vertebrate material is hardly represented in most temperate zone collections (Alberch, 1985), much less in tropical ones. The trend for biodiversity collections to be centralised further may in fact render collections even less accessible (Scoble, 1997), especially to scientists from less developed countries. For scientists from poorer countries, travel to the United States, Europe or the United Kingdom merely to examine (centralised) type specimens is inevitably beyond their means.

Collecting and populations

The objection has been made that specimen collecting "upsets" pristine ecosystems, and that serious disturbance is caused by killing animals. It is as if populations, particularly virgin areas, are fragile figurines on a shelf. Once broken, the set is compromised, and a portion has been lost forever. This leads to deterioration of the "pristine" condition, which must be avoided. It is clear from this view that population biology needs to be better communicated to the general public. Individuals, in fact, can never be conserved as all will eventually die; only populations and species can be conserved (Winker, 1996). No population in nature is ever static, but fluctuates substantially over time and space. Some long term research has shown that scientific collecting does not, in fact, affect the population levels of vertebrate species (Voris and Inger, 1995; Goodman & Lanyon, 1994). A population of yellow-lipped sea kraits, *Laticauda colubrina*, inhabiting a 150 m^2 island near Labuan, Sabah was sampled by Lading (1989), who collected every snake that could be found, eight times over a period of twelve months in 1988 in a study of reproductive ecology. From 1991 onwards, a capture-release study was conducted on this same small population. The effects can be seen in Figure 1, and illustrate the resilience of the majority of biological species. While reproductive rates and social structure may differ, even in the total absence of collecting, *no population of any vertebrate species will ever remain at the same level of abundance.*

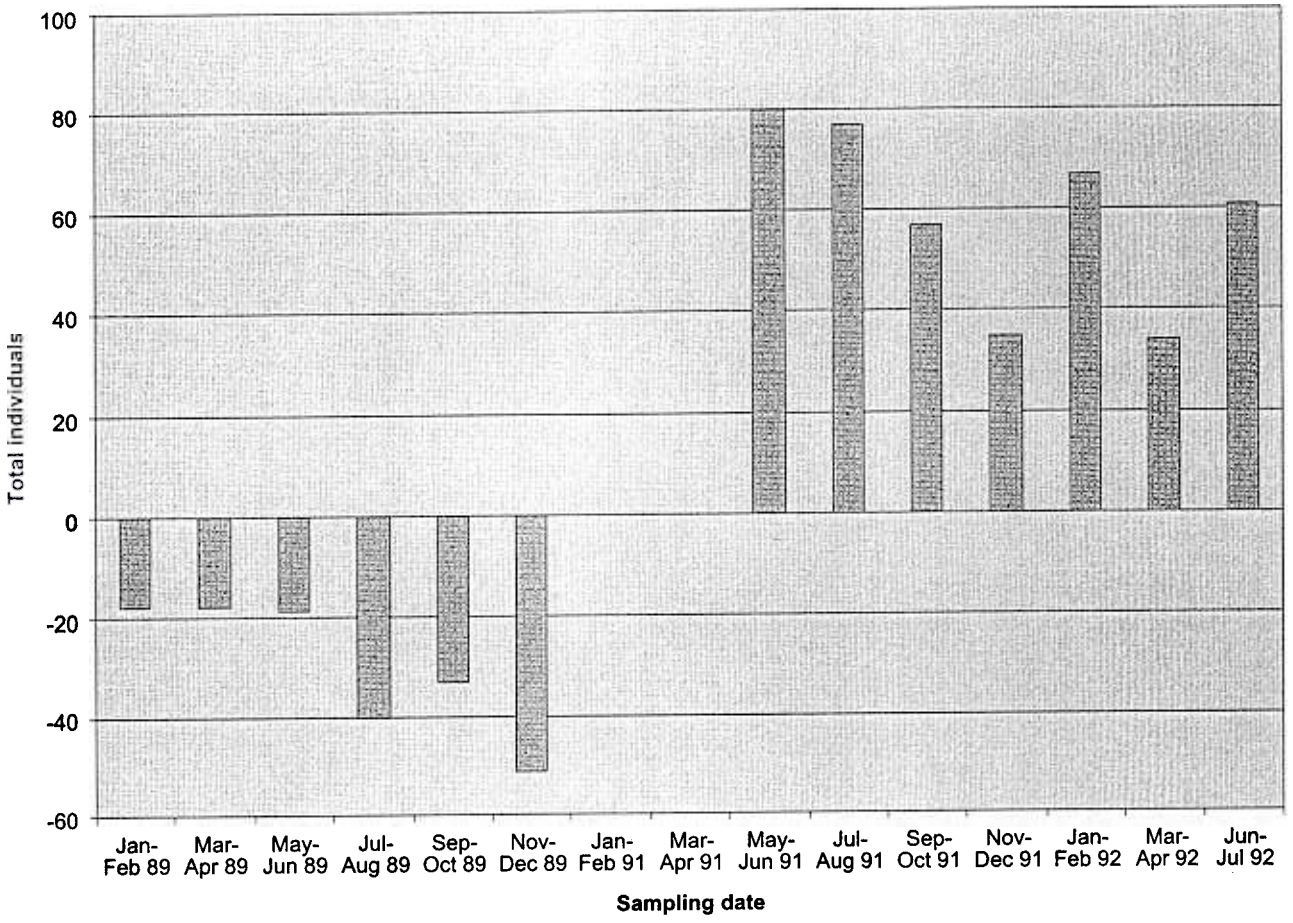

Fig. 1. Total sea snakes (*Laticauda colubrina*) found on Keraman Shoal, Labuan, 1989-1992 (negative totals represent snakes collected, no sampling was done in 1990).

This is *not* a recommendation to collect any species recognised as rare or endangered. Determination of status should not rest solely on field guides, however, often the only references for conservation workers or non-taxonomists. The original text of Smythies (1960), for example, states that the Blue-Rumped Parrot (*Psittinus cyanurus*) is "resident, but rather rare". This text was later amended because the species in fact occurs in tremendous abundance in the logged areas of central Sarawak. The change in abundance is probably related to habitat change in Borneo over the past 50 years (Stuebing, 1994). Interestingly, *Psittinus cyanurus* is still listed as "nearly threatened" by some authors (Collar, et al., 1995).

ETHICAL ISSUES

Killing appears to be the aspect of faunal specimen collecting that renders the practice unacceptable to many. Botanists are among the fortunate ones: specimens mean just a flower, fruit and a few leaves. With zoological specimens, a whole animal must be obtained. Of late, opposition to collecting has become a moral issue, to be decided not by scientists, but by ethicists. Nevertheless, as Goodman & Lanyon (1994) have pointed out, the number of birds collected from tropical forests is dwarfed by the mortality associated with the destruction of those forests. This kind of mortality rarely if ever becomes a moral issue, however. There is cause for concern when specimen collecting is held in violation of a moral system. This must be treated as a religious view, to be respected, but not to be imposed on others (Winker, 1996).

On a more positive plane, specimen collecting must be viewed in the same context as the taking of blood, or biopsies: useful, even critical to assess the health of a human patient (or by extension, the environment). In the case of natural animal populations, specimen collecting is at least as non-threatening, and as useful for diagnostic purposes as a blood test, or a biopsy. Populations "heal" rapidly. Unfortunately, natural habitats converted for plantation agriculture or industry, will not. The patient will already be dead before tests can be made.

FAUNAL SPECIMENS AS AN INTELLECTUAL RESOURCE

Fundamental to the value of zoological collections is their importance as an intellectual resource. It is no accident that countries with huge biodiversity collections such as the USA, United Kingdom, Australia, the Netherlands or France possess robust scientific establishments in the biological sciences. It is impossible that these collections been unimportant for academic and educational development. In fact, these great faunal samples have been the basis for an enormous scientific advantage in the biological sciences still held by western countries. Generations of young scientists have had direct access to this tremendous wealth of scientific information. The most important contributions to systematics and ecology during the last two centuries, from Richard Owen and Charles Darwin to J.B.S. Haldane and Ernst Mayer, were made by scientists who studied specimens, that the foundation for understanding of biological diversity.

Even now there is pressure for Malaysia to abandon collecting altogether. A rough analogy is in order: Let us suppose that the game of football is unknown in a country, but that the sponsoring of football teams would bring valuable income and recognition. A novice country might then logically request advice from one well established in football, to send professionals train amateur citizens in order to form a team. Let us also suppose that these experts advised

local players and coaches that physical practice sessions were unnecessary, but in fact could actually cause injury, and so were unwarranted. Suppose further that instead, these professional advisors confidently asserted that local teams could watch videos of a professional team from the advisors' own country, and by watching, painlessly learn without risk how to play the game. Suppose again that following this type of training, the novices would be expected to field a team for the World Cup. This is a totally ridiculous scenario, of course, but this is precisely the position that Malaysian faunal taxonomists and ecologists find themselves in when asked to "compete" academically at the international level. Without having collected, prepared and researched faunal specimens on their own, they will have been trained "by video", and can never hope to be sufficiently prepared. Indeed, they will be condemned to the status of perpetual amateurs, unable to compete, because they have been misled. The acquiring, managing and researching of scientific collections is the key provider of "intellectual muscle" on biodiversity and environmental issues.

THE FUTURE

How will these challenges be faced? The problems are grave, but not insurmountable. As always, solutions will depend on the actions of individuals with vision and determination, who it is hoped will be given support by enlightened politicians and other public servants. The solutions demand specific actions:

Train a new generation of animal taxonomists, not just PhDs (who often overly specialised) but young scientists with the energy and interest to develop broad-based taxonomic faunal collections for future use;

Re-emphasize field biology, whether systematics, ecology or behaviour, in university curricula to ensure that a generation of young scientists will be available and trained for the enormous task that remains;

Make specimen-based biodiversity research, not just of flora, but of fauna a priority, with strategic value. Give proper recognition to the important contributions of faunal systematics and taxonomy to the biological sciences as a whole;

Promote and build new museums to properly house valuable new collections in conditions that will guarantee the safety of specimens for a minimum of 100 years, or much longer. These new facilities should be designed to reduce or eliminate maintenance costs such as energy use, storage, etc., since it is often these aspects (cost cutting and its consequences) which have led to deterioration of faunal collections in the past;

Staff these new museums not only with specialists at the tertairy level but with sufficient technical staff who are field-oriented and trained in basic taxonomy and identification. This situation has existed in herbaria for decades, but has declined to alarmingly insufficient level for faunal collections in local museums.

Reinstate the role of museums as institutions for research, not merely exhibits of the past. Exhibits, while still vital, should in fact reflect this active research role in their educational content.

Revise existing policies to encourage museums to function as libraries, rather than banks. The use of collections for scientific research should, as in major Herbaria around the world, participate in the internationl community through mutual communication and sharing of research material.

These actions will automatically lead to solutions in related areas. For example, with good available collections, the quality and effectiveness of university teaching will be vastly upgraded. Furthermore, new facilities will obviate the traditional reluctance of foreigners to leave specimens behind, with the excuse that such specimens will be lost or eventually deteriorate in substandard facilities. Concurrently, the present shortage of local scientific collaborators will be overcome, so that the expertise of foreign scientists can be exploited to the fullest to produce technical output of truly mutual benefit.

Other benefits are legion, from a vastly improved database for Environmental Impact Assessments to new medical discoveries, not to mention the tremendous educational benefits to the younger generation, who should be given the opportunity to study faunal diversity, not just on paper or in photographs, but as fascinating, multidimensional organisms.

Nearly one hundred years ago, the founder of the Museum of Zoology at the University of California at Berkeley, Joseph Grinnell, wrote:

"It is quite probable that the facts of distribution, life history and economic status may prove to be of more far-reaching value, than whatever information is obtainable exclusively from the specimens themselves. At this point I wish to emphasize what I believe will ultimately prove to be the greatest value of our museum. This value will not, however, be realized until the lapse of many years, possibly a century, assuming that our material is safely preserved. And this is that the student of the future will have access to the original record of faunal conditions _wherever we now work. He will know the proportional constituency of our fauna by species, the relative number of each species and the extent of the ranges of species as they exist today".

Will *we* know?

ACKNOWLEDGMENTS

I am most grateful to R.F. Inger, Harold Voris, and Peter Ng for their encouragement, insights and discussions. Thanks is also due to Cheong Ek Choon, Tan Fui Lian, Ghazally Ismail, Lamri Ali, Patricia Regis, Barney Chan and Fred Sheldon for their help and support. Ruth Kiew and Ian Butler gave helpful comments on the manuscript. Special thanks to Heidi Robek for discussions and assistance in acquiring important references.

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