

A PROPOSAL FOR INTERDISCIPLINARY
INVESTIGATIONS IN NORTH CENTRAL SONORA

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Introduction

This proposal is designed to elucidate the initial phase of a long-term research commitment in interdisciplinary scientific study. Though it is not normally relevant, I shall begin with a discussion of the personal background that justifies and has led to the unique goals and objectives of the proposed research. The proposal then proceeds to an analysis of the present status and character of research in the study area and, finally, to a statement of the proposed work of this project. Though this format requires an additional measure of patience (and perhaps tolerance) of reviewers, I believe it is necessary because truly interdisciplinary scientific research has only rarely been carefully and systematically planned, and reviewers are not accustomed to the demands of proposals for such studies.

Background

As should be evident from my vitae and bibliography, I have been actively engaged in research involving the interface area of archaeology, geology and paleobotany for over fifteen years. I have also been deeply concerned with problems of the theoretical and methodological aspects and functions of research of this sort, and I have publicly argued that the application of research techniques traditionally used in one discipline to problems which arise in another discipline does not constitute an adequate definition of "interdisciplinary" scientific research (Schoenwetter 1962, 1967, 1970). Such activity may provide stimulus, and may reveal new information and perspectives, significant to the receptor discipline, but

I contend that interdisciplinary science must logically and practically require a unique methodology and perhaps a unique supportive philosophy.

Until now, I have been content to explore this matter only in logical terms and to the degree possible under the constraints of co-operative investigations which attempted to explore the potential of the research techniques of pollen analysis in archaeological investigation. To date, however, such work has been funded by the archaeologists with whom I have worked cooperatively and my primary responsibility has necessarily been to use and create palynological procedures to generate information consistent with specific archaeological research programs. I believe I have reached the point where the provision of such services to archaeologists is no longer particularly informative to the concerns of what I conceive as truly interdisciplinary research. In effect, the parameters of service work constrain opportunities for development of innovative methods and applications. Particularly, the archaeologists with whom I work should not be required to bear the expenses of development of new methods that may have little or no relevance to the project goals they have established. Though such methods may be valuable to Science or, ultimately, to archaeology as a discipline, the nature of truly interdisciplinary science should not be explored methodologically from the specific (and probably narrow) perspective of the applications of pollen study to archaeology. A broader approach, involving the orientations of several traditional sciences and attempting to deal with a wider variety of problems, seems likely to be required.

I submit that such methods and exploration should have as broad a basis as possible, and I wish to devote this project to that end. Because prior experience provides a basis for my assessment of the research needs and problems involved, I anticipate undertaking such work in Central Arizona and New Mexico, in the Northern Mississippi River Basin, and in arid Highland Mexico. This proposal presents a specific project for initiating this long-range program of interdisciplinary research, and can only be properly understood as the first step in such a program.

Character of the Proposed Research

The specifics of the research design presented here have two functions: (1) to accomplish interdisciplinary research in a way which will obtain results of importance and significance in the scientific study of the geographic area involved, and (2) to explore the theoretical and methodological parameters of interdisciplinary scientific research programs through analysis of controlled field tests of basic principles. I believe that most such principles are unknown to Science and none have been tested. The proposed work is designed to generate awareness of basic principles through post-hoc analysis of the problem resolutions achieved by the study. But two principles I feel have already been identified will guide the research effort and be tested by its successes.

The first principle is that interdisciplinary research requires an interdisciplinary methodology rather than a methodology patched together from research procedures in the various disciplines one desire to integrate for solution of a given problem. The second holds that a single common point of contact among the various disciplines must be identified which may serve as the integrating mechanism and base point to which each discipline may relate its individual theoretical structure.

The proposal assumes that the techniques of pollen analysis will constitute such a mechanism. In great part, I believe this to be true because pollen analysis is a research procedure that has no theoretical or methodological substance of its own. As Fageri and Iverson (1975:) have recently reiterated, pollen analysis is a technique and not a science. It is a set of procedures for obtaining information that is interpretable by reference to theoretical structures in such disciplines as botany, geology or anthropology. But these theoretical structures do not influence the nature of the procedures used to obtain palynological information, and application of different theories results in quite different biases significant to the interpretation of the results produced by a pollen study. Pollen analysis thus serves as a contact point for different disciplines and provides a single frame of reference for the various components of the interdisciplinary research. But it does not “steer” the overall work in directions

that cannot be justified by the normal theoretical structure of any one of the component disciplines.

The proposal also assumes that methodology derives from method, not vice versa, and that the test of a method is its success in achieving desired results. As the work I propose to do gets done, and methods are refined to accomplish that work in the interdisciplinary context I propose to establish, I anticipate that an awareness of the interdisciplinary methodology subtending such success will become evident. In essence, I submit that I have no intention of allowing potentially conflicting theoretical structures underlying methodologies in the various disciplines to constrain or direct the research in advance. Rather, I propose that the research will be undertaken as a suite of problems having a common point of contact but directed by the ways that have traditionally been used for resolution of such problems in the various disciplines. The end result will be analyzed in two formats of organization: (1) from the individual perspectives of the coordinated and co-operating disciplines as regards problems researched and resolved, and (2) from the integrated perspective of the point of mutual contact. In this latter analysis, I anticipate the nature of the interdisciplinary method and methodology will become exposed. But even if it were not, or if it were not expressible very clearly or unequivocally, the specific research problems would stand resolved.

I propose that the project be located in Central Sonora, Mexico, for a number of reasons. First, it is an area about which little has been published and little is known. This makes certain essential problem orientations obvious, and at the same time it obviates the necessity of resolving or relating to research orientations generated by others at earlier times. In such an area one is obliged to "get down to basics" in applying well-tested and well-comprehended procedures for data gathering. The subtleties of sophisticated research parameters which refine basic understandings (but which tend to yield conflicting interpretations) are not at issue in such a study area. This is significant in the proposed research, for it is my intention to explore basic principles and basic applications of interdisciplinary study. It seems judicious to undertake such work

first where complications are least likely to result from the prior biases of earlier workers dealing with dissimilar problems. Second, the present state of research in the area is such that a small number of workers have gained a great deal of experience and expertise recently, using modern field and analytic procedures, but they are all working as independent researchers. In this situation there exists a true test of the capability of an interdisciplinary study to function for the integration of scientific knowledge regarding the geographic area without diverting the interests, energies and plans of specialized workers. The cooperation of all the scientists involved has already been sought and granted. Finally, this relatively unpopulated area provides a great potential for recovery of raw data uncomplicated by the disturbing inroads of modern, technology-intensive, Western Civilization.

Goals and Objectives

The goal of the proposed study is an interdisciplinary investigation of botanical, historical, anthropological and geological variables significant to the scientific understanding of a region in central Sonora, Mexico. I anticipate that this research will resolve scientific problems in each of these disciplines that require application of palynological expertise. Formal analysis of the reasons the problems were successfully resolved will then be undertaken to identify the character of an interdisciplinary (rather than a multi-disciplinary) method of approach to the range of disparate problems. The interdisciplinary method will constitute something new and distinctive in Science, insofar as it must be designed to accommodate various and potentially conflicting theoretical structures underlying various disciplines into a cohesive statement. But whether or not it is successful in this regard, it shall serve as a case study of specifically interdisciplinary research which may be examined to reveal methodological principles intrinsic to studies of this character – a matter that has been not previously been explored pragmatically.

Specific research problems in floristic analysis, ethnobotany, ethnohistory and the history of protohistoric populations, archaeology and stratigraphy will be selected. With the exception of the last-named, on-going research in each of

these disciplines is on-going in the study area and the proposed project will function to strengthen them independently as well as integrate them in an interdisciplinary fashion. The selected research problems will have a common contact point: pollen analysis. Palynological techniques will be applied to solve the particular problems posed in each of the disciplines and also to identify and elucidate the requirements of a methodology for interdisciplinary analysis.

Present Status of Research in the Study Area

In 1973 Arq. Beatriz Braniff de Oliveros accepted the position of Coordinator of Archaeological Investigations at the newly-established Northwest Regional Center of the Instituto Nacional de Antropología e Historia at Hermosillo, Sonora. This office provided a focus and an organization for research in the Historical Sciences in the state of Sonora, which had been desultory through the 1960's and early 70's. In 1974 Dra. Braniff initiated a multidisciplinary study centered on the Rio San Miguel involving archaeological study supervised by her, ethnohistorical studies supervised by Dr. B. Fontana of the University of Arizona, historical studies of the mission period supervised by Arq. Jose Arturo de Oliveros, Director of the Regional Center, and ethnobotanical studies supervised by Dr. Richard Felger of the Arizona-Sonora Desert Museum. In 1975 Dr. Richard Pailes initiated a three-year program of archaeological research on the Rio Sonora and Rio Moctezuma. At the end of December 1975, each of these investigators had made substantial progress on the research problems they were working on. But, with the exception of projected plans for a mutual excavation-historical study of certain mission sites, no interdisciplinary research has been considered. Obviously all of the possible benefits to be obtained from the multidisciplinary effort will be explored when the various studies have been completed. But the research commitments of one investigator have not substantially influenced the work or research designs of any others.

Proposed Research Design

The proposed research design capitalizes upon the multidisciplinary value of the technique of pollen analysis as a means of linking the concerns of the various on-going projects without imposing constraints on work in progress. The

proposed effort, however, is something more than a lynch pin holding a chain of research interests together. It is designed to involve additional links in a chain that forges all the research into a cohesive unit. This unit provides the interdisciplinary case example that is the goal of the proposed project. But it also augments the database significant to each of the individual projects presently underway.

The archaeological project supervised by Dr. Pailes incorporates study of the pollen of sediment samples collected from site surfaces and site excavations in the Rio Sonora district. The first objectives of this aspect of Pailes' work are to identify the general character of any paleoecological variations that may have occurred during the period of aboriginal occupancy of the district, and to establish a pollen chronology that will serve to independently test hypotheses of relative chronology developed through analysis of the associated archaeological record. The credibility of such a chronology will be low until it is substantiated by a regional pollen chronology based upon samples derived from litho-stratigraphically controlled horizons. Such sampling would also be required for satisfactory substantiation of paleoecological reconstructions.

The proposed project will therefore undertake a regional-scale study of the Late Pleistocene and Recent stratigraphy of three river valleys. This research would be modeled on the successful work of Antevs, Bryan, Haynes and others in the American Southwest, just across the international border. In addition, an analysis of the Recent geomorphology of the study area will be undertaken to provide interpretations of two phenomena significant to comprehension of paleoecological variations: (1) an interpretation of sequential variations in landscape-forming conditions which resulted in the litho-stratigraphic sequence observed, and (2) an interpretation of sequential changes in hydrography in the study area. This research will reveal the significant and appropriate locations for pollen sampling of the litho-stratigraphic record and will provide a set of hypotheses regarding the nature and sequence of Recent paleoecological events, which may be tested by the biostratigraphic application of pollen analysis. In this regard the pollen study would be modeled on the highly successful work of

Martin (1963), Mehringer and Haynes (1965) and Oldfield (1975) in Arizona and New Mexico. The relationship of these geoscience studies and the archaeological investigations revolves about the mutual support the pollen data of the one provides for the other. Pollen study here serves to establish a means by which the database of either discipline may become immediately related to the database of the other discipline. In addition, pollen study augments and tests hypotheses developed independently in the two disciplines.

One of the principal reasons pollen chronologies developed on the basis of sediment samples of archaeological site-context may be suspect is that the deposition of such sediments is likely to have been strongly affected by human behavior. If the pollen rain trapped in these deposits is likely to have significantly affected by human activities referent to plants, flowers or pollen which was undertaken at the time and place from which the sample is drawn, certain biostratigraphic principles basic to the development of pollen chronologies may be violated. These disadvantages to the establishment of a pollen chronology, however, are potentially significant advantages for the study of the relationship of human behavior patterns to the resource base represented by flowering plants. They are also of considerable interest to those concerned with affects human behavior may have upon sedimentation in the context of archaeological sites. If in fact human behavior functions to create differences between the pollen records of archaeological and non-archaeological contexts, those differences must logically be an identifiable and characterizable aspect of the resulting pollen record. The "aberrant" behavioral factor can then be isolated and eliminated from the database used for development of the pollen chronology, and also considered in its own terms and treated as an artifact open to anthropological analysis and interpretation.

Though no investigator has yet been able to isolate and characterize aspects of the pollen rain of an archaeological context that are provably referent to specific patterns of human behavior, studies have been undertaken which strongly suggest that research along these lines would be very profitable. In a classic study of the pollen records of the archaeological site of Broken K, Hill and

Hevly (1968) determined that the proportions of pollen of cultivated and gathered plants varied in patterned ways depending on the architecture of the sampled room. This was interpreted in terms of the probable activity patterns represented in the various room types of the site (habitation, storage, ceremonial). Such research does not prove the capability of pollen studies to reveal and document patterns of prehistoric behavior. At best, it demonstrates that activity areas of some sorts may be identifiable by their effect on local pollen rains and “tracked” on prehistoric levels through pollen analysis. But it strongly suggests that places where specific patterns of human behavior are consistently undertaken are likely to have particular, isolable, pollen rains. If one is able to identify the palynological effect of a behavioral cause, it should be possible to rigorously test a hypothesis of prior occurrence of the behavior pattern at an archaeological locus through the techniques of pollen analysis. Such a test would constitute a direct, independent, test of an ethnographic analog.

The proposed research will capitalize on, and augment, the ethnobotanical investigations presently underway by Felger in order to investigate the capability of pollen analysis to reveal and elucidate patterns of prehistoric ethnobotanical behavior. This will be accomplished in four ways, each of which has a different kind of relevance in studies of the prehistoric record. The first form of investigation will concentrate on sampling and analysis of pollen records from modern villages in the study area. The concern here will be to identify those aspects of modern pollen rains which characterize behavior patterns undertaken in the environs of (and within) domiciles that relate to the manipulation of plant resources native to the area or known ethnohistorically as common exotic cultigens. Hopefully, such things as room function relationships to pollen rain or the relationships of food processing areas to pollen rain will be thereby revealed.

A second aspect of the study will concentrate on sampling areas where plant resource maintenance and development behavior occurs. The research design will adapt multivariate methods for isolating and characterizing those components of the pollen rain that result from farming and other activities undertaken for the maintenance and growth of plants used as human resources.

As a contrast and control, the same methods will be applied to samples of modern pollen rain collected at loci of other forms of resource exploitation behavior (e.g. household fuel collection, wild food harvesting, collecting medicinals). It will also be applied to suites of samples collected from resource zones at locales where specific and regular human activities that might systematically affect local pollen rain are not known to occur.

It will be difficult to obtain statistically satisfactory numbers of samples from all the subtypes of the resource zones, resource behavioral areas, ecological manipulation areas and domestic areas. But a yet more significant problem is the necessity to obtain adequate information regarding the nature of the behavior patterns involved and the loci of their performance. In the present instance a skilled ethnobotanist has been engaged in the study of one of the three river valleys of the study area for some time and has spent many years working in adjacent areas of Sonora and Arizona. Working through this investigator, who already knows of competent informants and much about behavior patterns of concern to the proposed research, it is anticipated that the great bulk of sampling can be accomplished in the course of two field seasons.

The ethnobotanical research involved in these studies is *emic*: that is, dependent on the worldview of the informant. To relate this work to the *etic* Categories and units of biological reality known to Western Science it will be necessary to undertake two further sorts of palynological study. These will be specifically designed to deal with floristic data of significance to systemic and ecological analysis in botany and to paleoecological reconstruction.

Common sense dictates that we recognize that ecological variables affecting the survival of the plants from which the pollen is dispersed must also affect the pollen. Ecological variables affecting the maturation of the embryonic pollen grains during the period prior to flowering, and ecological variables affecting the flowering mechanism, must also have crucial affect on the amount of pollen produced and dispersed. But it must further be recognized that a set of ecological variables affecting pollen grains that do not affect the parent spermatophytes play crucial roles in the character of the modern or fossil pollen

rain. Pollen grains do not have the same adaptive functions as their parent spermatophytes, they do not exist in the same sorts of environments, and they are not subject to the same limiting factors. Indeed, the male gametophyte contained within the protective cell wall of the pollen grain has a wholly independent existence from the parent plant during a portion of its life cycle, and it is only during this period that the pollen grain has opportunity to be included in pollen rain.

A pollen grain that is never dispersed beyond the confines of a flower may fulfill its reproductive role but has no affect whatever on the composition of the pollen rain. Further, those pollen grains that do fulfill a reproductive role are not likely ever to become incorporated in a sedimentary matrix. The pollen that falls upon soil or water surfaces, or foliage surfaces (or on human mucous membranes, for that matter) is of no reproductive or adaptive value to the plant population that produced it. The pollen rains studied by pollen analysts are, actually, wholly biological waste product surpluses. The grains we are able to recover from the fossil record have not even served as food products for decomposer organisms functioning in an overall ecological system of evolutionary significance.

Ecological variables of extraordinary significance to gametophyte functioning and survival, such as wind strength and direction or atmospheric temperature and humidity during a short flowering period, may have no particular effect on the functioning and survival of the parent spermatophytes. Such variables will, however, affect pollen rain and the pollen records of sediment samples because they will produce more or fewer waste products in the reproductive process. Ecological variables affecting the functioning and survival of the decomposers of those waste products during the period of pollen rain burial, and ecological variables affecting the nature of the process of burial itself, will also affect pollen records but have no necessary effect on the parent population of spermatophytes. When one compounds the set of ecological variables affecting the vitality of the spermatophyte population, the set affecting the vitality of the gametophyte population, the set affecting pollen rain burial and

the set affecting the pollen decomposers with the set of effects on the pollen rain that may be induced by human behavior directed toward the parent plants and the environments in which they are adapted to survive, it is truly astonishing that pollen rains in fact have regularly patterned relationship to the floras which produce them. Yet this is very evidently the case. Fossil pollen records reveal themselves as so highly and consistently patterned that they are relied upon almost entirely for reconstruction of paleoenvironmental conditions in the Recent Period by geologists, and they are demonstrably of sufficient consistency to allow correlation of geological deposits in earlier periods. Surface pollen samples reveal pollen rains with consistently patterned relationships (by both qualitative and quantitative tests) to the floras with which they are associated and which they ostensibly reflect.

Such patterning and consistency strongly indicates that though the set of ecological variables affecting a specific pollen record may be a complex one, it is highly responsive to and conditioned by a small set of natural laws that control expression of the pollen record in a regular and specific way. Since we do not know what these laws are, we cannot necessarily predict that a given set of circumstances will produce a specific pollen rain. But we may undertake controlled investigations of their operation so as to come ultimately to know the nature of those laws through the scientific method. This is done by identifying that component of the pollen rain that is the ostensible effect of a specific ecological variable or set of variables. Currently, multivariate analysis of the numerical data derived from samples of modern pollen rain associated with specific floras is the most sophisticated technique available for this purpose.

The study area displays a rugged topography of foothills and mountains composed of many sorts of granitic and sedimentary rocks. The resultant variety of substrates, aspects and elevational positions contributes strongly to a diversity of plant taxa and disjunct distributions of plant communities. The latitude of the area compounds this effect, as it is close enough to the Tropic of Capricorn to provide a meeting ground of northerly distributions of sub-tropical taxa and southerly distributions of temperate taxa. The general aridity of the area, and its

strongly seasonal distribution of rainfall, provide additional variables that influence the establishment of diverse and distinctive taxa. Dr. Felger's years of research undertaken in Sonora are the background of knowledge necessary for floristic analysis of the study area, but opportunity to initiate such research has not yet been available to him.

A floristic survey of the area is proposed as part of the present research program because, on the one hand, it is critical that floristic units such as the plant communities and plant associations of the area should be recognized, mapped referent to recognizable controlling ecological variables (e.g. frost-line, substrate type, hydrographic situation) and sampled for pollen rain. Such interpretations serve as a control on the pollen records of emic categories and will provide data critically pertinent to paleoecological reconstructions and of the biostratigraphic significance of the fossil pollen records. On the other hand, the floristic survey will provide collections of the plant taxa of the study area from which pollen reference specimens may be obtained. These will be required for comprehensive identification of the pollen of the sediment samples and will also be valuable for systemic studies one may anticipate will be fostered by the availability of the collections of samples.

The historical and ethnohistorical research efforts of Fontana and de Oliveros have just been begun and have not yet reached the point that specific problems appropriate to joint investigation through pollen analysis have been recognized. It is known, however, that the introduction of domestic animals and Old World crop plants preceded the first missions in the area and perhaps even the first European explorations of the area. Such historical events should be identifiable palynologically. Comparison of their palynological expressions with the pollen records of the prehistoric period should significantly amplify comprehension of both horizons and serve to provide connecting links across the boundary between behavioral research in history and archaeology.

Plan of Research

The research is planned as a three and one-half year program, for which funding is requested during the last 36 months. The great bulk of field work in

floristic survey, ethnobotanical study, geomorphology-stratigraphy and surface pollen sampling will be undertaken in the first funded year. This will be subsequent, however, to a significant quantity of non-funded fieldwork in archaeological and historic site pollen sampling in the previous six months. The second funded year will be principally devoted to the accumulation of pollen records from various contexts. In the final year, the requested funds will be used mostly for statistical and methodological analysis of results. It is expected that a number of reports significant to the subdisciplinary interests involved will be generated in the third year of the project. Preparation of a monograph-length report of the interdisciplinary program – the principle goal of the proposed research – is planned for the final six months of the funded project.

Non-funded Research Schedule

1974 Pailes' archaeological survey of Rio Sonora and Rio Moctezuma

Felger completes study of Seri ethnobotany and begins ethnobotany of lower Rio San Miguel

1975 Pailes' intensive survey and testing of Rio Sonora archaeology

Braniff's survey and testing of archaeology of Rio San Miguel

De Oliveros initiates investigation of Mission Period records and locations in Rio San Miguel

Felger develops ethnobotany of upper and middle Rio San Miguel

1976 Braniff, de Oliveros, Pailes involved in large-scale excavations; Braniff completes field operations

Fontana completes ethnohistorical sources bibliography

Felger completes field studies of Rio San Miguel ethnobotany

Schoenwetter initiates analysis of samples collected by Pailles in 1975 (Jan-May) then develops and undertakes pollen sampling programs allied with on-going ethnobotanical and archaeological field work

Funded Research Schedule

- 1977 January (1) Analysis of the pollen samples collected 1976 begins
(2) Stratigrapher-geomorphologist begins field work
(3) Floristic survey work begins
- May (4) Schoenwetter in field for stratigraphic pollen sampling
- June (5) Schoenwetter in Rio Moctezuma district with Pailles excavation crew for pollen sampling
(6) stratigrapher completes fieldwork
- July (7) Schoenwetter in field with Felger for floristic zones pollen sampling
- August (8) Stratigraphy-geomorphology report due
- Sept. (9) Analysis begins of samples collected 1977
- Dec. (10) Reference pollen samples collected as part of floristic survey submitted for analysis
- 1978 March (11) Floristic survey report due
(12) Identification of joint pollen-historical/ethnohistorical problems completed; research initiated on this aspect of the project
- June (13) Final field pollen sampling initiated
- Sept. (14) Statistical studies initiated
- Dec. (15) Preliminary reports of results submitted to co-operating researchers
- 1979 Dec. (16) Complete first draft of monograph-length study of interdisciplinary research

