The Origin of Indonesian "Pamor"

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The kris is a dagger with a decorated blade and an ornamentally carved pistol-grip handle. It is peculiar to Indonesia, which here is meant to include Malaya as well as the archipelago itself. Some of the hilts are decorated with precious stones and metals, exhibiting in both form and decoration a strong Hindu influence. The surfaces of a kris blade show designs similar to those found on Damascus swords and Indian gun barrels. For this reason, it has been suggested that the technique for making these *pamor* [1] patterns, as the blade designs are called, either originated [2] in Persia or India, or was influenced [3] by Persian and Indian examples. I shall present here evidence involving both the dating of the origin of *pamor* and the technique of its manufacture, which leads to the conclusion that Indonesian *pamor*-technique is of local origin.

Dating

The word *kris* appears in even the earliest known Javanese inscriptions, dating back at least to the ninth century A. D. Not till the eleventh century, however, does it seem to serve to differentiate the *kris* from the more prosaic dagger (*curiga*, *těwěk*). In the poem *Ardjuna-Wiwāha*,[4] the term *keris* alone is used to describe the weapon favored by warring gods. Possibly, the ordinary dagger had by this time achieved new status due to the introduction of *pamor*; this is conjecture, however.

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[1] Literally *mixed*, from the Sanskrit root *mor*. The term refers to the fact that blades with *pamor* are made from several metals, and thus in a sense mixed, although not, as we now know, *alloyed*.

[2] J. E. Jasper and Mas Pirngadie, *Inlandsche Kunstnijverheid in Netherlandsch Indie*, Vol. V, *De Bewerking van Niet-Edele Metalen* (The Hague, 1930), Chapter IX.

[3] A. Leroi-Gourhan, "Notes pour une histoire des aciers," *Techniques et civilisations*, Vol. II (1951), p. 7.

[4] Arjuna-Wiwaha, XXV, 6; also XXXIV, 1. (Before 1040 A. D.)

No special attention is paid to Indonesian weapons in the records of the travels of Chinese merchants and missionaries [5] until the end of the thirteenth century, when, in the *History of the Sung Dynasty*, are mentioned certain gifts sent to the Emperor by the King of Java. These consisted of:

> . . . ivory, pearls, silk embroidered with flowers and gold, silk of different colors, sandalwood, cotton goods in various colors, tortoise shell, betel trays, short swords with hilts of rhinoceros horn or gold, rattan mats plaited with figures. . . .[6]

The reference here to the handles of the short swords could well serve to describe many of the ornamental handles used on the krisses that have survived [7] to this day. Also, it may be noted that no mention is made of the blades being unusually ornamented, although the detail of the description indicates that such mention would have been made had the blades been anything special.

A copperplate inscription [8] in Old Javanese, dated 1323 A. D. as translated by Sarkar, refers to "magically forged" weapons, again hinting at something special, but only the word *tĕwĕk*, not *kris*, appears.

The earliest reference that can be considered to describe *pamor* explicitly is in Ma Huan's *Ying-yai Sheng-lan* of 1416, a recountal of the Chinese expedition to Madjapahit:

> The king . . . carries one or two short daggers called *pu-lak* . . . The men have a *pu-lak* stuck in their girdle, everybody carrying such a weapon from the child of three years up to the oldest man; the daggers have very thin stripes and whitish flowers and are made of the very best steel, the handle is gold, rhinoceros horn or ivory, cut into the shape of human or devils' faces and finished very carefully. . . .[9]

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[5] All references to Chinese sources are taken from W. P. Groeneveldt, *Historical Notes on Indonesia and Malaya Compiled from Chinese Sources* (Jakarta, 1960), which in turn is a reprint of his original article in *Verhandlingen van het Bataviaasch Genootschap van Kunsten en Wetenschappen*, Vol. XXXIX (1880).

[6] Groeneveldt, *op. cit.*, p. 17.

[7] The manufacture of krisses for ritual purposes seems to have ceased about 1940. At that time krisses were made for the Pakualaman in Jogjakarta by the smoth of Mojudan. This smith still lives there but has not taught the art to his sons. The writer knows of no kris makers who are practicing at present.

[8] *Tuhañaru* (see L. C. Damais, *Bulletin de l'école française d'extreme orient*, Vol. XLVI, No. 1 (1952), p. 1, for classification). The translation by H. B. Sarkar appears in the *Journal of the Greater India Society*, Vol. II, p. 152.

[9] Groeneveldt, *op. cit.*, p. 46.

Ma Huan was impressed, and rightly so, for the aesthetic effect of *pamor* is most striking, and indeed has caused one writer suddenly to wax poetic in the midst of a scholarly paper on the history of steel.[10] Examples of *pamor*, chosen from among the forty distinct types in the pattern-book of His Highness Paku Alam VIII of Jogjakarta, are shown in Figure 1.[11] These demonstrate the range of effects attainable. The description given above of the *pu-lak* blades obviously applies as well to the krisses in Figure 1.

It would thus appear that, although we know little of the origins of the kris itself, the earliest date assignable to the occurrence of *pamor* is early fourteenth century A. D. The earlier Chinese sources could be interpreted as providing evidence negating the existence of *pamor* before that time. Certainly, although the kris existed before then, there was nothing about the blades to attract attention. Only in the early fourteenth century did the dagger become, for the Indonesian, something very much more than a simple weapon. From that time on, the weapon was also an ornament, a ritual object, in some legends a god (or at least the spiritual counterpart of its wearer), and an indispensable property for the actors in Indonesian drama.[12] It is reasonable to suppose that the kris became all these only with the introduction of *pamor*.

Pamor Technique

In appearance, the blades with *pamor* are quite similar to damascened blades of Persia and India, to Tibetan sabres, Merovingian swords, Caucasian knives, and Japanese swords. This similarity of appearance has led some writers to assume that the techniques of manufacture of all were of common origin, or at least in some places derivative from others. Many of these attributory references preceded the realization that damasking in Persia and India involved a technique of heterogenizing a mixture of metals which is now called *poulad*, while *pamor* is made by forge-welding of laminates of steels of differing composition. These distinctions are described so well in the review articles of

[10] Leroi-Gourhan, *loc. cit.*

[11] The originals of Figure 1 are water color drawings in black and white generously loaned to me by His Highness for reproduction here. Also I was shown a dozen kris which had been ordered by His Highness from the pattern book in 1940 and made by the kris-maker of Mojudan. The desired patterns were achieved, although not without blemishes and minor defects. Unfortunately, I have not yet been able to obtain photographs of the finished blades.

[12] For a detailed discussion of these roles of the kris see Rassers, W. H., "On the Javanese Kris," in *Panji, the Culture Hero: A Structural Study of Religion in Java* (The Hague, 1959).

Leroi-Gourhan and Smith [13] that they need not be repeated here. Most recently there appeared an excellent brief discussion of the distinctions between *poulad* and *pamor* by Panseri.[14] That there is a strong distinction between the methods of manufacture of *poulad* and *pamor* is well established.

In addition, Leroi-Gourhan divides *pamor* into three sub-classifications. We follow his lead and list the locales of weapons with decorated blades as follows:

Poulad: Persian damask, Indian wootz.
Pamor: Merovingian swords, Japanese sabres, Tibetan sabres, Caucasian knives, and Indonesian krisses and swords.

The three types of *pamor* are *simple pamor*, *true pamor*, and what Leroi-Gourhan calls *corroye fin*, for which the author can offer no English equivalent.[15] The first of these, called in Indonesian *pamor rambut* (hair-*pamor*), is the effect obtained when the blades are simply diffusion-welded flat bundles of rods or wire, the pattern being obtained by differential attack by acids or age upon the metal itself and the scale inclusions that separate the individual wires. There is no complexity to the designs manifest with *simple pamor*; some look like coarse hair. Examples of *simple pamor* are found in the earliest Madjapahit krisses [16] (*circa*, as we have seen, 1350 A. D.), Tibetan sabres of the nineteenth century,[17] and modern Indonesian fakes made for tourists.

True pamor is made from bundles of alternating layers of metals of differing composition, usually of two kinds of metal. These bundles are hammer-welded into thin plates, stretched out, cut to length, restacked, rehammered, and so forth, with intermediate distortion such as twisting and buckling, and then flattened; finally several such composite pieces are hammer-welded together onto a flat core piece of hardened steel which will provide the edge.[18] The visual effect is

[13] Leroi-Gourhan, *loc. cit.*; C. S. Smith, "Decorative Etching and the Science of Metals," *Endeavor* (Oct. 1957), p. 199.

[14] C. Panseri, in his review of the metallurgy sections of the *History of Technology* (Singer *et al.*) in *Technology and Culture*, Vol. I, No. 4 (1960), p. 392. Panseri unfortunately used the word "soldered" where the words "diffusion-welded" would be less confusing.

[15] Examples of *corroye fin* patterns are not "fine" compared to the delicate textures exhibited by *true pamor*.

[16] G. B. Gardner, *Keris and Other Malay Weapons* (Singapore, 1936); Leroi-Gourhan, *loc. cit.*

[17] Smith, *loc. cit.*

[18] J. Groneman, *De Vordiringen der Pamor-Smeedkunst* (*Meteooren Nikkel Pamor*), (Surabaja, 1906); Jasper and Pirngadie, *op. cit.*

obtained by etching lightly the finished surface with compounds that darken one of the metals more than the other or else emphasize the scale inclusions that outline the boundaries of the individual pieces that made up the blade. No heat treatment is employed, either to improve the mechanical properties nor to enhance the decorative aspect of the blade.

In this regard it is to be noted that Groneman actually observed the manufacture of a kris and reported the steps in the manufacture in great detail. Earlier Rosenhain reported on the manufacture of Malay krisses,[19] basing his report on a second-hand account. But he also made metallographic studies of some of the materials used; he found that the two kinds of metal reportedly used were really only one kind of iron, concluding therefrom that the design was provided by the traces of the weld-imperfections on the finished surface. It is true that certain designs can be obtained in that way, but certainly not all. One would expect that patterns of narrow, almost linear texture such as that of Figure 1a, could be obtained using only a single kind of metal, but it is doubtful that the other designs shown, involving broad areas of alternating light and dark components, could be so made. Groneman emphasizes that the Javanese smiths who worked in the palaces of the kings would only consider of true value those krisses which were made from steel or iron *and also* a nickel-iron alloy that had been won from a meteorite that had fallen on Java. In fact, Groneman was trying to convince the smiths of Java that they could do as well with imported nickel alloys; he even had at least one kris made with pure nickel supplied by Krupp. Some modern krisses, reportedly,[20] are made from old bicycle frames which contain about five per cent nickel.

Thus the impression left by Rosenhain's work is quite incomplete if Groneman's reports are to be trusted. Accordingly, I have undertaken a metallographic study of a few kris blades of uncertain origin. While this study has only just begun, still it is valuable to this discussion to present some of the preliminary results.

A kris with a curved blade, of *pamor* "drifting hair" (a narrow pattern with no broad contrasting areas on the surface, similar to that in Figure 1a), was sectioned, polished, etched, and examined with a reflecting microscope at several magnifications. Figures 2a and 2b are transverse and longitudinal cross sections, respectively, from a region near the center of the blade section. The greatest thickness of the blade was about three millimeters. It is clear that the kris was made by

[19] W. Rosenhain, *Journal Anthropological Institute*, Vol. XXXI (1901), p. 161.
[20] Jasper and Pirngadie, *op. cit.*

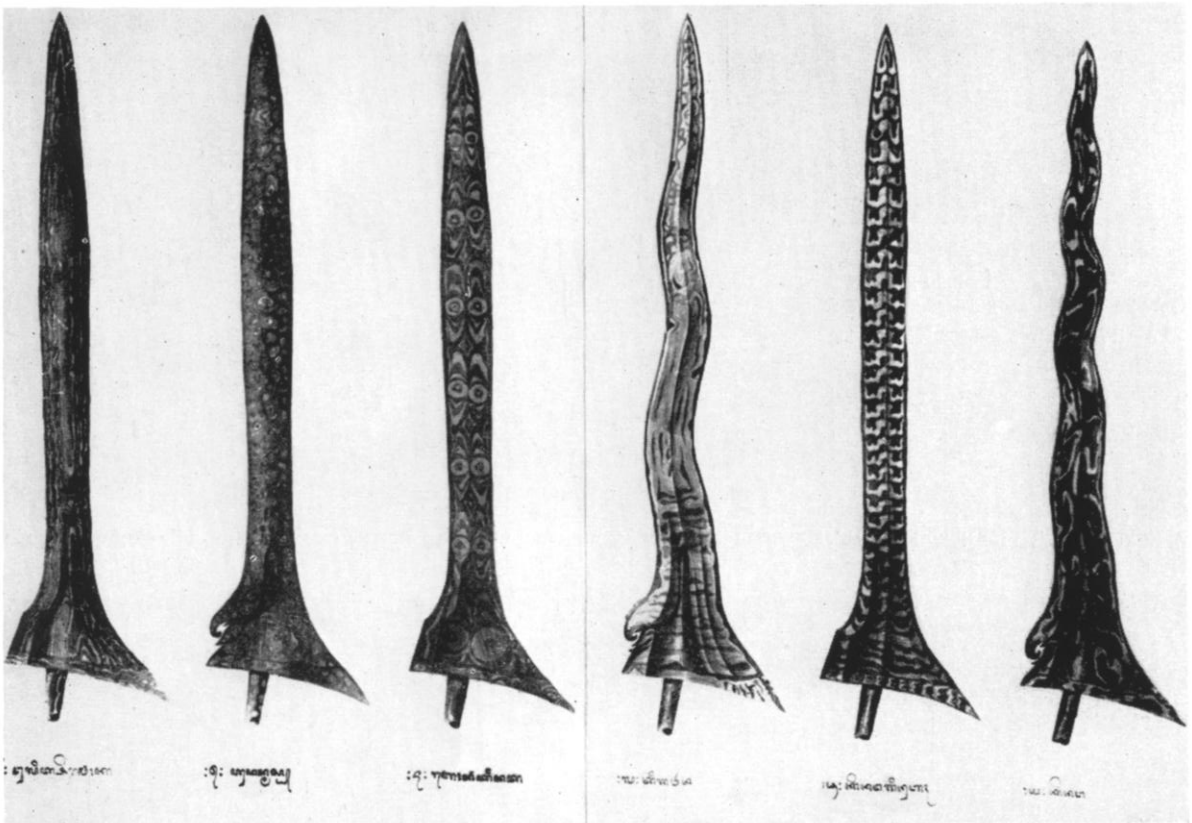
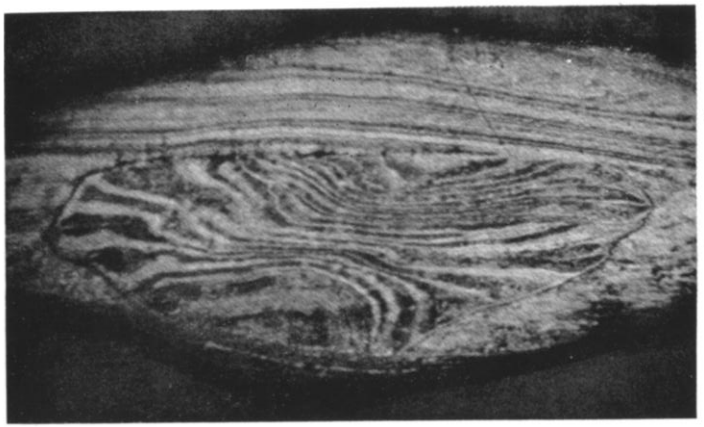
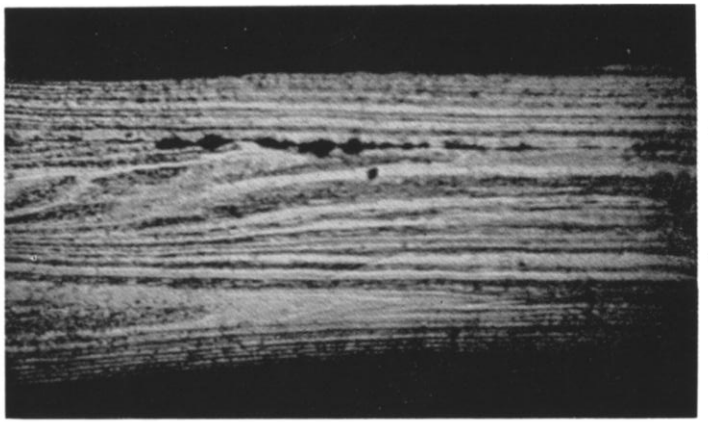


Figure 1. Examples of Indonesian Pamor Patterns:

(a) *Ngulit semånkå* (" Watermelon skin ")
(b) *Udan mas* (" Golden rain ")
(c) *Bonang tinåtå* (" Arranged *bonang* pieces ": The *bonang* is one of the percussion instruments of the Javanese gamelon [orchestra]; it consists of ten or fourteen bronze " pots " on a bed-like frame.)
(d) *Tiga warnå* (" Tricolor ")
(e) *Kenångå ginubah* (" A string of flowers: *Canangium odoratum* ")
(f) *Kenångå* (" Kenanga flower petals ")



2a



2b

Figure 2. Microphotographs of the Cross-section of an Indonesian Kris. (2a) Transverse, (2b) Longitudinal. (Original 20X)

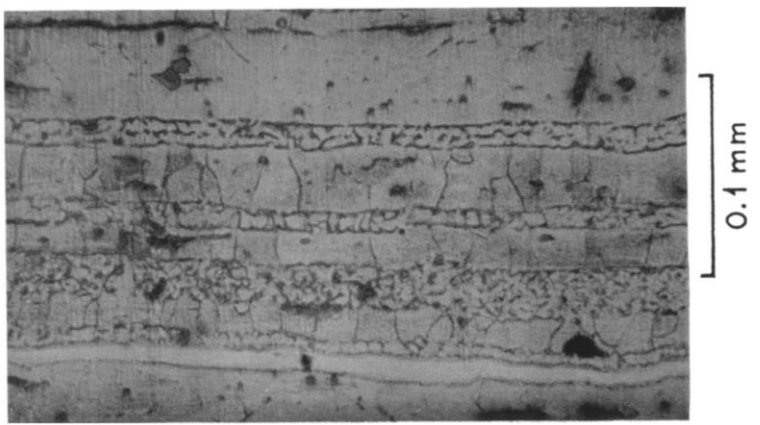


Figure 3. A Detail of the Longitudinal Cross Section. (Original approximately 300X)

diffusion welding many layers of at least two different kinds of metal. X-ray fluoroscopy reveals that 5.5 per cent by weight of the total material used was nickel, with 0.6 per cent carbon, and the remainder iron. Chromium, manganese, and molybdenum were absent. We presume that the two metals differ markedly in carbon content. (Tests for relative carbon content are soon to be performed, as well as tests for the effect of various heat-treatments, microhardness surveys, and x-ray diffraction and fluoroscopic analysis, all of which will be reported later in a paper devoted solely to the metallurgy of the kris.)

We learn from Figure 2 that a multi-layer cross-section may underlie even a simple almost-linear pattern. Figure 3 was made from the longitudinal section at a much greater enlargement than Figure 2b. In that micrograph one sees some of the finer details of the layered structure underlying true *pamor*.[21]

The kris used was purchased by the writer from a peddler of antiques in Jogjakarta. It was not reputed to have special properties; it was of no ritual value; and it had no museum value (appraisers who examined it at my request assured me that it was an ordinary kris, and not a very good specimen at that). Yet it is composed of layers of metal of the order of 0.01 mm. thick. It is reasonable then to suppose that revered blades might consist of hundreds of layers.

More to the point of the present study, however, is the fact that the kris used was obtained by no special means. It would be highly fortuitous for me to have inadvertantly picked up an unusual specimen. Thus, even the ordinary krisses that may be found in Indonesia today, krisses of indeterminate age and origin,[22] exhibit characteristics that manifest a high degree of skill in hand-forging operations. The craftsmanship of the Indonesian kris-maker is comparable to that of the French pastry-maker; it is questionable which works with the more intractable medium. It is safe then to state that the common kris is an example of *true pamor* and that the best examples must certainly represent the highest state of advancement of the art of hammer-welding.

Other weapons exhibiting *true pamor* are the Merovingian blades

[21] Much more is to be learned from such micrographs. Such analyses will be presented in a forthcoming paper, when enough different blades have been studied to permit generalization.

[22] All "antique" krisses look very old; it is a common saying that a few months' burial in the soil of Java is equivalent to a hundred years of real time in the air. The kris studied appeared to be very old. In fact, the unequal thicknesses of the outer layers of the sections in Fig. 2 suggest that wear and corrosion have reduced the original thickness of the blade by an amount that could be estimated and converted to age. This appears too speculative, however.

dated to the end of the ninth century,[23] seventeenth-to-nineteenth century Caucasian blades [24] and possibly also the twelfth century (?) Japanese blades discussed by Smith,[25] although it is not clear that those blades exhibited *true pamor*.

The third type of pamor, *corroye fin*, is similar to true pamor, except that only a very few layers are involved, and then only near the edge of the blade.[26] Accordingly *corroye fin* could well be the intermediate stage in the development of *true pamor* from *simple pamor*. Examples of this intermediate type of *pamor* are Japanese sabres of the sixth century, Indonesian swords of indeterminate date, and seventeenth-to-nineteenth century Caucasian knives.

Analysis

It is now reasonable to eliminate immediately the possibility that Indonesian *pamor* is a transplant from either Persia or India, or one through the other, simply because there is no *pamor* represented in the weapons identified with these regions. Further, we can rule out all other possible origins except Japanese on the basis of inconsistent dates. At first the writer was led by the remarkable similarity in the methods of manufacture of the Merovingian blades, as revealed by the metallurgical studies of France-Lanord and the descriptions of kris manufacture by Gardner and Groneman, to consider a connection between the two regions. However, even if there were contact between the Vikings, for example, and the Indonesians, the four-hundred year gap between the disappearance of the Viking blade and the appearance of *pamor* in Indonesia seems a formidable obstacle to the possibility of such a transfer. If one considers the date (before 1040 A. D.) of the change of emphasis in Javanese terminology from *tĕwĕk* to *keris* as indicative of the introduction of *simple pamor*, then the disparity in dates of the kris and the Viking blades is much smaller. One must then look for significant connection between Europe and Indonesia at about the tenth century. At present, however, this remains conjectural.

The disparity-in-date argument can also be used to cast doubt on the possibility that Indonesian *pamor*-smiths were even inspired by Indian metal-work. The external appearance of wootz is similar to that of *pamor*, leading one to conjecture that *pamor* may have arisen

[23] A. France-Lanord, " Les techniques metallurgiques appliquées à l'archéologie," *Revue de Metallurgy*, Vol. XLIV, No. 6 (1952), p. 418.
[24] Leroi-Gourhan, *loc. cit.*
[25] Smith, *loc. cit.*, p. 202.
[26] Leroi-Gourhan, *loc. cit.*

as a result of the smith trying to imitate the Indian work. However, the period of intense Indianization of the Indonesian archipelago was ended during the eighth century,[27] and *pamor* did not appear until the fourteenth. This seems too long for a memory to survive, although we would have to reconsider this if examples of the Indian art can be found to be mentioned in the Javanese literature of the fourteenth century.

There remains the possibility that pamor technique was transferred between Indonesia and Japan. Two factors speak against this. First, there are no records of actual contact between the two peoples before 1605 A. D., when the Dutch East India Company established trade with Japan. If a connection existed previously it must have been with the Chinese traders and missionaries as agents. But if this were so, then the Chinese reports would have mentioned it, or at least not have exhibited the "discovering" tone that permeates the passage quoted earlier from Ma Huan. Further, only in Indonesia are all three kinds of *pamor* found. This points to an orderly development of the technique from the simplest *parmor rambut* to the *true pamor*. The same arguments would preclude, if it were still necessary, the possibility of transference from Tibet via China.

We must therefore conclude that the *pamor* exhibited by the Indonesian kris is of local origin, independent of developments elsewhere.[28]

[27] For dates in ancient Indonesian history, see the Appendix in B. H. M. Vlekke, *Nusantara* (Cambridge, Mass., 1945).

[28] Insinjur Pragnjono Mardjikoen of the Department of Civil Engineering, Gadjah Mada University, has given invaluable assistance in this study, especially in translating from the Dutch. Ins. Arjono assisted with the metallography. P. J. Zoetmulder, S. J., Professor of Javanese at Gadjah Mada University, has been extremely helpful in discussions and generously provided the references to and translations from the Old Javanese. Thanks are due His Highness Paku Alam VIII for opportunities for discussion and permission to photograph the pattern book in the Pakualaman. Also, the helpful comments of Professor C. S. Smith of M. I. T. and Professor Lynn T. White, jr. of U. C. L. A. are gratefully acknowledged.