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MABEL COOK COLE'S *PHILIPPINE FOLK TALES*: AN ETHNOASTRONOMICAL ANALYSIS

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Abstract: Although anthropologists, and more recently astronomers, have studied and published on the astronomical beliefs and practices of different Philippine ethnic groups, one other source of information available to ethnoastronomers is the astronomical data contained in myths and legends. This paper analyses the astronomical stories contained in the book *Philippine Folk Tales*. These stories were compiled and annotated by the American anthropologist Mabel Cook Cole and published in 1916, and they focus on indigenous views of the Sun, the Moon and the stars. Most of the 'folk tales' in Cole's book derive from northern Luzon and ethnic groups in the Davao district on the island of Mindanao.

Keywords: Philippines, Mabel Cook Cole, ethnoastronomy, folktales, Philippine meteorites, mtDNA studies

1 INTRODUCTION

Although the Philippines was probably first occupied by *Homo erectus* individuals more than 700,000 years ago (Ingicco et al., 2018), our knowledge of Philippine indigenous astronomical systems post-dates the arrival of *Homo sapiens* in the archipelago around 67,000 years ago (Détroit et al., 2019; Mijares et al., 2010). Most of that account derives from Ambrosio's majesterial *Balatik*, recently translated into English by two of the authors of this paper (Torres and Dela Cruz, 2021), and from the publications by Casiño (1967; 1976), Schlegel (1967; 1987; 1999) and Revel (1990). There is also invaluable ethno-astronomical information in the records of Spanish missionaries and others, and reported in Blair and Robertson (1903–1909).[1] These currently are also the focus of our research group.

One other source of information about Philippine ethnoastronomy is myths and legends, which has long been a target for research at both a local and an international level (e.g. see Barton, 1955; Cole, 1915; Miller, 1904; Rahmann, 1955). In this paper we examine astronomical myths and legends included in the book *Philippine Folk Tales* by Mabel Cook Cole (1916), and especially the practices, beliefs, and indigenous views relating to the Sun, the Moon and the stars. We analyse them on the basis of their origins, ethnic affiliations, and the impact of foreign—including religious—influences.

Figure 1: Mabel Cook Cole (https://www.wikitree.com/photo.php/8/85/Cole-24842.jpg)

In Section 2, below, we provide biographical information about Mabel Cook Cole and her anthropologist husband, Fay-Cooper Cole. In Section 3 we introduce *Philippine Folk Tales* and in Section 4 discuss their astronomical content, and add supplementary data included in *Balatik*. In Section 5 we compare and contrast these myths and legends, discuss possible references to meteorite impacts, and review the myths and legends in light of ideas about human population movements into the Philippine region during the past 50,000 years.

2 MABEL COOK COLE: A BIOGRAPHICAL SKETCH

Mabel Cook Cole (Figure 1) was born Mabel Elizabeth Cook in Plano, Kendall (Illinois, USA) on 18 April 1880 and died in Los Angeles on 13 November 1977. According to Wikipedia (Mabel Cook Cole, n.d., b), she

Figure 2: Professor Fay-Cooper Cole https://en.wikipedia.org/wiki/Fay-Cooper_Cole#/media/File:Fay-Cooper_Cole_(1881-1961).jpg

> … specialized in the study of ancient man and in studying the people of the Philippines. Her books include *The Story of Primitive Man*, *The Story of Man*, *Savage Gentleman*, and *Philippine Folk Tales*.

Elsewhere in the above-mentioned Wikipedia web site entry Cole's occupation is listed as "Author and anthropologist" and her Genre as "Children's literature; also Philippine anthropology topics."

After attending Plano High School Mabel Cook enrolled at Northwestern University, graduating in 1903 (Mabel Cook Cole, n.d. (b)). It was while she was an undergraduate student that she met Fay-Cooper Cole (1881–1961; Figure 2), and they married (Eggan, 1963: 642). Fay-Cooper Cole also graduated in 1903, and he then joined the Field Museum in Chicago as an ethnologist. At the time the Museum was rapidly expanding its collections, and Cole was given the choice of several expeditions. He chose the northern Philippines, and he and his wife would spend 1907–1908 in the village of Patok, and later Manabo, learning about Tinguian life:

> With Mrs. Cole's assistance, he measured a sample of Tinguian men and women, recorded the language, *collected myths and folktales*, and studied all aspects of their culture, in addition to making an extensive collection for the museum and visiting neighboring groups in the interior. (Eggan, 1963: 642; our italics).

Then in 1910–1912 Fay-Cooper and Mabel Cook Cole were in the Philippines again, this time to study the Islamized tribes on the island of Mindanao, but their visit "… was cut short by malignant malaria which almost cost the Coles their lives." (*ibid*.).

After returning to Chicago, Fay-Cooper Cole was very busy preparing "… a monograph on The Wild Tribes of the Davao District, Mindanao (1913) …" (*ibid.*), and he then wrote up his earlier study of Tinguian folklore for his doctoral thesis with Columbia University (Cole, 1915a). Subsequently, this was expanded and published by the Field Museum as *Traditions of the Tinguian* (Cole, 1915b).[2] Meanwhile, Mabel Cook Cole was busy with her own study of Philippines' myths and legends, which appeared the following year as the book under discussion in this paper. Certainly she was widely-recognized as an anthropologist by the time she became a "… charter member of the Women Anthropologists Group with Margaret Mead and a number of others …"

(Mabel Cook Cole, n.d., b).

3 *PHILIPPINE FOLK TALES*: AN INTRODUCTION

Philippine Folk Tales (Figure 3)[3] was based upon data that Mabel Cook Cole collected and annotated while with her husband in the Philippines, and was published in Chicago (USA) in 1916. She explains that she became aware of these folk tales on the very first evening when they arrived in the village of Manabo:

> It was a weird spectacle. Coming out of the darkness, we were almost convinced that we had entered a new world. Against the blackness of the night, grass-roofed houses stood outlined in the dim light of a bonfire; and squatting around that fire, unclad save for gay blankets wrapped about their shoulders, were brown-skinned men smoking long pipes, while women bedecked with bright beads were spinning cotton. As they worked in the flickering light, they stretched their distaffs at arm's length into the air like witches waving their wands; and with that the elfland picture was complete.
>
> In the stillness of the night a single voice could be heard reciting some tale in a singsong tone, which was interrupted only when peals of laughter burst forth from the listeners, or when a scrawny dog rose to bark at an imaginary noise until the shouts of the men quieted him and he returned to his bed in the warm ashes. Later we learned that these were the regular social gatherings of the Tinguian, and every night during the dry season one or more of these bonfires were to be seen in the village. (Cole, 1916: Introduction).

In the course of the following four years Mabel Cook Cole and her husband

> … frequently heard these stories, either related by the people in their homes and around the camp fires or chanted by the pagan priests in communion with the spirits. The tales are now published in this little volume, with the addition of a few folk-legends that have appeared in the *Journal of American Folk-Lore* and in scientific publications, here retold with some additions made by native story-tellers. (Cole, 1916: 1).

As the Content listing in her book indicates, Cole selected 'folk tales' from the Tinguian and neighbouring Igorot of northern Luzon; the Tagalog, mainly from central Luzon; "… the Wild Tribes of Minanao" (*ibid.*), namely the Bilaan, Bukidnon and Mandaya from the Davao District; the Moro from Mindanao, the Sulu Archipelago and Palawan; and Visayan groups, mainly from the islands of Samar, Leyte, Bohol, Cebu, Negros and Panay. See Figure 4 for localities mentioned in this paper.

According to the web site Mabel Cook Cole (n.d., a)

> Cole's tales shares the wonder, magic and superstition of the Philippines, and gives American readers a new appreciation for their culture.

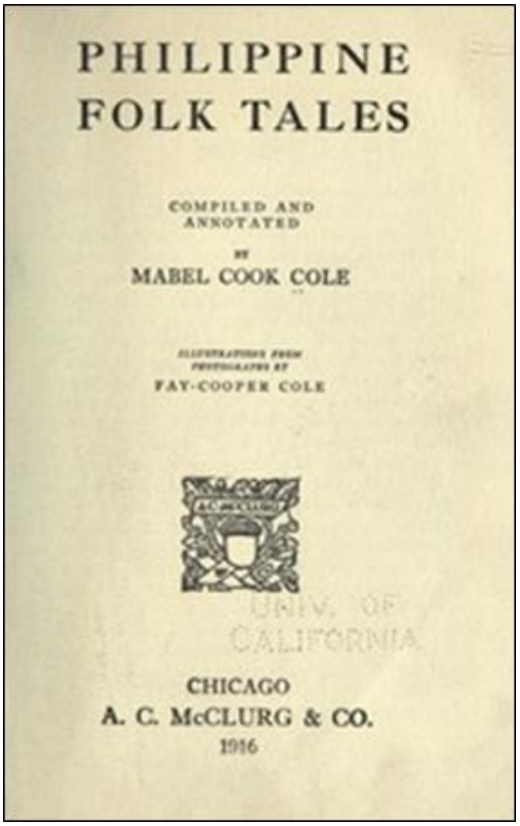


Figure 3: The cover of Mabel Cook Cole's *Philippine Folk Tales* (after Cole, 1916).

4 ETHNOASTRONOMY IN *PHILIPPINE FOLK TALES*

The Philippines is an archipelago with more than one hundred different ethnolinguistics groups (see Saito, 2019), where knowledge of and practices relating to the Sun, the Moon and the stars vary widely (Torres and Dela Cruz, 2021). In this paper we only sample a small selection of these ethnic groups, progressing geographically within the Philippines from the north to the south.

4.1 The Tinguian

4.1.1 Introduction

The Tinguian ethnic group occupied the valleys of the Abra River and surrounding mountains in northern Luzon (Figure 4), and

Figure 4: Map of the Philippines showing the main islands, the location of the Tinguian and neighbouring Igorot ethnic groups in northern Luzon (the brown ellipse), the Visayan area (white ellipse), and the Bukidnon, Bilaan and Mandaya ethnic groups (the red, purple and black ellipses, respectively) in Mindanao (map modifications: Wayne Orchiston).

and Fay-Cooper Cole (1922: 258) describes them as

> … a rather short, well-built people with moderately high, brachycephalic heads, fairly high noses, and angular faces. Their hair is brown black and inclined to be wavy, while the skin varies from a light olive brown to a dark reddish brown … [but] within this group there are great extremes in stature, head and nasal form, color, and the like, indicating very heterogeneous elements in its make-up … When compared to the Igorot, greater differences are manifest; but even here, the similarities are so many that we cannot classify the two tribes as members of different races.

Cole (1916: Preface) explains that

> In order to appreciate these tales to the fullest extent, we must understand the point of view of the Tinguian. To him they embody all the known traditions of "the first times"—of the people who inhabited the earth before the present race appeared, of the ancient heroes and their powers and achievements. In them he finds an explanation of and reason for many of his present laws and customs.

Furthermore,

> A careful study of the whole body of Tinguian mythology points to the conclusion that the chief characters of these tales are not celestial beings but typical, generalized heroes of former ages, whose deeds have been magnified in the telling by many generations of their descendants. These people of "the first times" practiced magic. They talked with jars, created human beings out of betel-nuts, raised the dead, and had the power of changing themselves into other forms.

4.1.2 Aponibolinayen and the Sun

According to this tale, one day Aponibolinaven and her sister-in-law went to the forest to gather the tender leaves of the *siksiklat* vine, which were very good to eat. Aponibolinayen cried out with joy when she had found the vine, but although she pulled on the leaves as hard as she could, they would not come loose. Then

> … and all at once the vine wound itself around her body and began carrying her upward.
>
> Far up through the air she went until she reached the sky, and there the vine set her down under a tree. (Cole, 1916).

Aponibolinayen was very surprised to find herself in the sky. She began to explore, and not far away she found

> … a beautiful spring surrounded by tall betel-nut trees whose tops were pure gold. Rare beads were the sands of the spring, and the place where the women set their jars when they came to dip water was a large golden plate. (*ibid.*).

Nearby Aponibolinayen saw a small house, and she was filled with fear lest the owner should find her there, so she climbed to the top of a betel-nut tree and hid there.

Now it turned out that the owner of the house was the Sun, Ini-init, but he

> … was never at home in the daylight, for it was his duty to shine in the sky and give light to all the world. At the close of the day when the Big Star took his place in the sky to shine through the night, Ini-init returned to his house, but early the next morning he was always off again. (*ibid.*).

From her hiding-place at the top of the betel-nut tree, Aponibolinayen saw the Sun when he came home that evening, and next morning she saw him leave. She was very hungry so once Ini-init had gone she went into his house. There she cooked some rice, and into a pot of boiling water she dropped a stick that immediately became fish. After eating a filling meal she lay down on Ini-init's bed and slept.

Late that afternoon Ini-init returned from from the sky and went to fish in the river near his house. He caught a big fish, and while he was cleaning it he happened to look towards his house and was startled to see that it appeared to be on fire. He immediately hurried home, but when he reached the house he saw that it was not burning at all. Upon entering,

> … On his bed he beheld what looked like a flame of fire, but upon going closer he found that it was a beautiful woman fast asleep.
>
> Ini-init stood for some time wondering what he should do, and then he decided to cook some food and invite this lovely creature to eat with him. He put rice over the fire to boil and cut into pieces the fish he had caught. (*ibid.*).

The noise of this awakened Aponibolinayen, and she slipped out of the house and back to the top of the betel-nut tree. Ini-init did not see her leave, and when the food was ready he called her, but the bed was empty and he had to eat alone. That night he could not sleep well, for all the time he was wondering who the beautiful woman could be.

Next morning he rose as usual to go off to shine in the sky, and once again Aponibolinayen stole into the house and cooked food, but when she returned to the betel-nut tree she left rice and fish ready for Ini-init when he returned home. Late in the afternoon Ini-init went into his home, and when he found pots of hot rice and fish over the fire he was greatly troubled. After he had eaten he walked a long time in the fresh air, and concluded that the food must have been prepared by the lovely woman who looked like a flame of fire. He decided to catch her if she came to his house again.

The next day Ini-init went up into the sky as usual, but in the afternoon he called to the Big Star to hurry and take his place because he was impatient to go home. As he approached his house he saw that it again look-

ed as if it was on fire. He crept quietly up the ladder, and when he had reached the top he sprang in and shut the door behind him. Aponibolinayen was cooking rice over the fire, and was surprised and angry that she had been caught. But Ini-init gave her betel-nut that was covered with gold, and they ate together and told each other their names. Then Aponibolinayen took up the rice and fish, and as they ate they talked together and became acquainted.

After some time Ini-init and Aponibolinayen married, and every morning Ini-init would go off to shine in the sky, and upon returning home at night he always found his dinner ready. But he began to worry about where the food came from, for although he brought a fine fish home every night, Aponibolinayen always refused to cook it.

One night Ini-init watched her prepare their meal, and he saw that instead of using the nice fish he had brought, she only dropped a stick into the pot of boiling water. "Why do you try to cook a stick?" he asked, and she answered, "So that we can have fish to eat." Ini-init worried: "If you cook that stick for a month, it will not be soft." (*ibid.*). But Aponiboliinayen only laughed, and night after night she cooked the same stick and there was always plenty of nice soft fish to eat. Ini-init was greatly troubled by this, for he saw that although the stick always supplied them with fish, it never grew smaller. He then realized that Aponibolinayen had magical powers.

One night not long after this Aponibolinayen told Ini-init that next day she wanted to go with him into the sky. Ini-init tried to dissuade here, pointing out it was hot up there and she would not be able to withstand the heat. But Aponibolinayen insisted, saying that she would bring blankets and pillows with them that would protect her from the heat. Again and again Ini-init begged her not to accompany him, but she insisted on going, so early one morning they set out. First, they went to the east, and

> … as soon as they arrived the Sun began to shine, and Aponibolinayen was with him. They traveled toward the West, but when morning had passed into noontime and they had reached the middle of the sky Aponibolinayen was so hot that she melted and became oil. Then Ini-init put her into a bottle and wrapped her in the blankets and pillows and dropped her down to earth. (*ibid.*).

It just happened that one of the women from Aponibolinayen's town was at the spring collecting water when she heard something fall near her. Turning to look, she beheld a bundle of beautiful blankets and pillows which she began to unroll, and inside she found the most beautiful woman she had ever seen. Frightened at her discovery, the woman ran as fast as she could to the town, where she called the people together and told them to come at once to the spring. They all hastened to the spring and were very surprised to find Aponibolinayen, for they had searched everywhere for her. Her father asked Aponibolinayen where she had been and she lied, telling them that she had come from Pinda-yan, where their enemies kept her captive until she was able to escape one night while they were asleep.

All were filled with joy that Aponibolinayen had returned, and they decided that they would perform a ceremony for the spirits and invite all their relatives who were mourning for Aponibolinayen. As they began preparing for the ceremony Aponibolinayen asked her mother to prick her little finger where it itched,

> … and as she did so a beautiful baby boy popped out. The people were very much surprised at this, and they noticed that every time he was bathed the baby grew very fast so that, in a short time, he was able to walk. Then they were anxious to know who was the husband of Aponibolinayen, but she would not tell them, and they decided to invite every-one in the world to the ceremony that they might not overlook him. (*ibid.*).

So they sent for the betel-nuts that were covered with gold, and when they had oiled them they commanded them to go to all the towns and compel the people to come to the ceremony.

As the guests arrived, the people watched carefully for anyone who might be Aponibolinayen's husband, but none appeared and they were greatly troubled. Finally they went to an old woman named Alokotan, who was able to talk with the spirits, and they begged her to find what town had not been visited by the betel-nuts. After she had consulted the spirits the old woman said: "You have invited all the people except Ini-init who lives up above. Now you must send a betel-nut to summon him. It may be that he is the husband of Aponibolinayen, for the siksiklat vine carried her up when she went to gather greens." (*ibid.*).

So a betel-nut was called and told to summon Ini-init. The betel-nut then went to Ini-init's house, and invited him to a ceremony that Aponibolinayen's father and mother were planning. Eventually Ini-init agreed to attend, and as soon as Aponibolinayen and the baby saw him, they were very happy and ran to

meet him. Then the people knew that this Ini-init was her husband, and they waited eagerly to meet him. As he drew near, however, they saw that he did not walk, for he was round; then they perceived that he was not a man but a large stone. They were very angry to find that Aponibolinayen had married a stone.

Aponibolinayen then set off with the stone for his home. However, "No sooner had they arrived … than he became a handsome man, and they were very happy." (*ibid.*). Ini-init then decided that after one month they would have a ceremony for the spirits, and he would pay a bride-price to Aponibolinayen's father and mother.

This pleased Aponibolinayen very much. Then they sent oiled betel-nuts to summon Aponibolinayen's relatives to the ceremony, and when they reached the town where the ceremony was to be held they were very surprised indeed to discover that the 'stone' had become a handsome man. After they all feasted and celebrated for one month, Ini-init and his wife decided to go down to the Earth and live there amongst her relatives.

4.1.3 The Story of Gaygayoma

In this story, Ini-init from Section 4.1.2, above, has become Aponitolau.

One day, while Aponitolau sat weaving a basket under his house, he began to feel very hungry and longed for something sweet to chew. He then called to his wife Aponibolinayen, suggesting they go to a vacant field and plant some sugar-cane.

Aponibolinayen went to the spring with a bamboo tube, and while she was filling it with water, Aponitolau made some sugar-cane cuttings. Then they went together to the field, and once there Aponitolau

> … loosened the soil with his long stick and set out the cuttings he had brought, while his wife sprinkled them with water from the bamboo tube. And when they had filled the field, they returned home, happy to think of the splendid cane they should have. (*ibid.*).

Aponitolau was impatient to see the new plants grow, so he used magical power so that the sugar-cane would grow very fast. Soon the stalks were tall and ready to chew. Aponibolinayen was very proud of her powerful husband.

Now about this time Gaygayoma, who was the daughter of Bagbagak, a big star, and Sinag, the Moon, looked down from her home in the sky, and when she saw the tall sugar-cane growing below, she was seized with a desire to chew it. So she asked her father to send some stars down to the Earth to collect some of the sugar-cane.

Bagbagak sent the stars down, and they collected some stalks of the sugar-cane and picked up some beans with golden stems that Aponibolinayen had planted. Gaygayoma was delighted with the things that the stars brought her. She cooked the beans with the golden stems and spent long hours chewing the sweet cane. When all the beans and sugar-cane were finished Gaygayoma grew restless and urged her father to take her to the place where the sugar-cane grew as she wanted to see it for herself.

Bagbagak then called on many of the stars to accompany them, and they all followed Gaygayoma down to the field where the sugar-cane grew. Some sat on the bamboo fence surrounding the field, while others went to the middle of the field, and all ate as much as they wished.

The following day Aponitolau was worried that the carabao might break through the fence and eat his sugar-cane, so he told Aponibolinayen that he was going to the field to check on the bamboo fence. Once there he found that the fence was intact, but he kept finding the sugar cane stalks that the stars had chewed, and he knew that someone had been there. He went into the middle of the field, and there on the ground was a piece of gold, and he said to himself: "How strange this is! I believe some beautiful girl must have chewed my cane. I will watch tonight, and maybe she will return for more." (*ibid.*).

That evening he hid in the tall grass near the field and waited. By and by

> … dazzling lights blinded his eyes, and when he could see again he was startled to find many stars falling from the sky, and soon he heard someone breaking the cane. Suddenly a star so large that it looked like a flame of fire fell into the field, and then a beautiful object near the fence took off her dress which looked like a star, and she appeared like the half of the rainbow. (*ibid.*).

Never had Aponitolau seen such sights, and lay shaking with fear. What shall I do? He worried that if he frightened the companions of the beautiful girl, they might eat him. Then with great effort he jumped up and frightened the stars until they all flew away, and when the pretty girl came looking for her dress she found Aponitolau sitting on it. "You must forgive us," she said, "for your sugar-cane is

very sweet, and we wanted some to chew." (*ibid.*). Aponitolau told her that she was welcome to the sugar cane, then he gave her some betel-nut and as they chewed together and talked they exchanged names. He told her that he was Aponitolau, the husband of Aponibolinayen, and she told him that she was Gaygayoma, the daughter of Bagbagak, a big star and Sinag, the Moon, and that she lived in the sky. Then she said: "And now, Aponitolau, even though you have a wife, I am going to take you up to the sky, for I wish to marry you. If you are not willing to go, I shall call my companion stars to eat you." (*ibid.*). Aponitolau shook with fear, for he knew now that the woman was a spirit; and as he dared not refuse. Soon after, the stars dropped a basket, and Gaygayoma and Aponitolau were drawn quickly through the air up to the sky. They were met by Gaygayoma's father.

After Aponitolau had lived with the stars for some time, Gaygayoma asked him to prick between her last two fingers, and as he did so a beautiful baby boy popped out. They named him Takyayen, and he grew very quickly and was strong.

All this time Aponitolau had never forgotten Aponibolinayen who, he knew, was searching the Earth for him, but he had been afraid to mention her to the stars. When Takyayen was three months old, Aponitolau decided to tell Gaygayoma of his wish to return to the Earth.

At first Gaygayoma would not listen to him, but he pleaded so hard that she finally agreed to let him go for one month. If he did not return at the end of that time, she said she would send the stars down to eat him. Then she called for the basket again, and they were lowered to the Earth. There Aponitolau got out, but Gaygayoma and Takyayen returned to the sky.

Aponibolinayen

> … was filled with joy at the sight of her husband once more, for she had believed him dead, and she was very thin from not eating while he was away. Never did she tire of listening to his stories of his life among the stars, and so happy was she to have him again that when the time came for him to leave she refused to let him go. (*ibid.*).

That night many stars came to the house. Some stood at the windows, while others stayed outside by the walls, and they were so bright that the house appeared to be on fire. Aponitolau was very frightened, and pleaded with his wife to hide him so the stars could not eat him. But before Aponibolinayen could reply, Bagbagak himself called out: "Do not hide from us, Aponitolau, for we know that you are in the corner of the house. Come out or we shall eat you." (*ibid.*). Trembling with fear, Aponitolau accompanied the stars back to the sky, leaving Aponibolinayen very sad and lonely.

After that Aponitolau made many trips to the Earth, but at Gaygayoma's command he always returned to the sky to spend time with her.

One day when Takyayen was a little boy, Aponitolau took him down to the Earth to see his half-brother, Kanag. The world was a wondrous place for the boy from the sky, and he wanted to stay on Earth forever. But after some time, while he and Kanag were playing out in the yard, big drops of water began to fall on them while the Sun was still shining. Kanag could not understand this but Aponitolau explained that these were the tears of Gaygayoma, who sees her son down on Earth, and weeps for him. Takyayen then returned to his mother in the sky, and she was happy again.

After that Takyayen was always glad when he was allowed to visit the Earth, but each time when his mother's tears began to fall, he returned to her. When he was old enough, Aponitolau selected a wife for him, and after that Takyayen always lived on the Earth, while Gaygayoma stayed in the sky.

4.1.4 How the Tinguian Learned to Plant

In ancient times the Tinguian originally were hunter-gatherers, and collected plant foods that grew in the forests and fish that lived in the mountain streams. Neither did they know how to cure people who became ill or were injured by evil spirits, and many died who might otherwise have lived.

Then

> … Kadaklan, the Great Spirit who lives in the sky, saw that the people often were hungry and sick, and he sent one of his servants, Kaboniyan, to the Earth to teach them many things. (*ibid.*).

This is how it happened. Dayapan, a woman who lived in Caalang, had been sick for seven years. One day when she went to the spring to bathe, a spirit with him entered her body, and he gave her rice and sugar-cane and told her to take them to her home and plant them in the ground, and

> … after a while they will grow large enough to reap. Then when they are ripe, build a granary to put the rice in until you shall need it, and a sugar-press to crush the cane. And when these are finished, make the ceremony Sayung, and you will be well. (*ibid.*).

Dayapan was filled with wonder at these strange things, but she took the rice and the sugar-cane and went home as she was commanded. While she was trying to plant them in the ground the Spirit again entered her body and showed her just what to do. Since then the Tinguian have planted crops every year, and because they do as Kaboniyan taught the woman they have plenty to eat.

When Dayapan had reaped the first rice and cane, she began to make the Sayung ceremony, and the Spirit came again and directed her. And when it was finished and she was cured, he told her to take a dog and a rooster and go to bathe in the river as a sign that the ceremony was finished. So she went to the river and tied the dog and the rooster near the water, but while she was bathing the dog ate the rooster.

Dayapan wept bitterly at this and waited a long time for Kaboniyan, and when at last he came, he said: "If the dog had not killed the cock, no person would die when you make this ceremony; but this is a sign, and now some will die and some will get well." (*ibid.*). Dayapan then called all the people together, and told them the things that the spirit had taught her; and they could see that she was healed. After that, when people became ill they called Dayapan to treat them, and "… it was as the Spirit had said: some died and others recovered." (*ibid.*).

4.1.5 The Sun and the Moon

Once the Sun and the Moon quarreled with each other, and the Sun said: "You are only the Moon and are not much good. If I did not give you light, you would be no good at all." (*ibid.*). But the Moon answered: "You are only the Sun, and you are very hot the women like me better, for when I shine at night, they go out-doors and spin." (*ibid.*). These words made the Sun so angry that he threw sand in the Moon's face, and we can still see the dark spots on the face of the Moon today.

4.2 The Igorot

4.2.1 Introduction

As Cole (1916) points out, 3–4 days' journey to the east and south of the Tinguian are Igorot ethnic groups (Figure 4),

> … but so difficult are the trails over the mountains and through the swift rivers that there is little intercourse between the two tribes, consequently, each believes the other a people to be feared ... Each group leads its own life and is governed by its own spirits.

Watching over the Igorot, monitoring their health, and controlling the winds and the rains, in order to providing good rice harvests, is the Great Spirit, Lumawig, who lives in the sky. He is believed to have created the Igorot, and at one stage even lived among them on the Earth in the Igorot village of Bontoc, where he married a Bontoc girl. The stones of their house are still to be seen in the village today. Ever since he moved into the sky Lumawig has taken a great interest in the Igorot, "…teaching them how to overcome the forces of nature, how to plant, to reap and, in fact, everything that they know." (*ibid.*). While he no longer visits the Igorot, each month people perform a ceremony where they pray to him to protect them and entreat him to favor them with health and good crops.

Cole (1916) notes that there is a close resemblance between Lumawig and the aforementioned Kaboniyan of the Tinguian. For more on the Igorot see Jenks (1905).

4.2.2 The Creation

In the beginning there were no people on the Earth. Lumawig, the Great Spirit, came down from the sky and cut many reeds. He divided these into pairs and he placed them in different parts of the world and he said to them: "You must speak." (*ibid.*). Immediately the reeds became people, and in each place there was a man and a woman who could talk, but the language of each couple differed from that of the others.

Then Lumawig commanded each man and woman to marry, which they did. Eventually there were many children, all speaking the same language as their parents. These in turn married and had many children, and "… in this way there came to be many people on the earth." (*ibid.*).

Lumawig saw that there were various things that the people on Earth needed, so he set to work to supply them. He created salt, and told the inhabitants of one place to boil it down and sell it to their neighbors. But these people did not understand the directions he gave, and when he next visited them, he found that they had not touched the salt. So

> … he took the salt away and gave it to the people at a place called Mayinit. These did as he directed, and because of this he

> told them that they should always be owners of the salt, and that the other peoples must buy of them. (*ibid.*).

Then Lumawig went to the people of Bontoc and told them to get clay and make pots. They got the clay,

> … but they did not understand the moulding, and the jars were not well shaped. Because of their failure, Lumawig told them that they would always have to buy their jars, and he removed the pottery to Samoki. (*ibid.*).

In this way Lumawig taught the people and brought to them all the things which they now have.

4.2.3 Lumawig and his Sons

Once upon a time, when the Earth was flat and there were no mountains, there lived two brothers who were the sons of Lumawig, the Great Spirit. The brothers were fond of hunting, but since there were no mountains there was no good places to catch wild pigs and deer. So the older brother suggested that they should get water to flow over all the Earth, causing mountains to rise up. This they did, and when water covered the Earth

> … they took the head-basket of the town and set it for a trap. The brothers were very much pleased when they went to look at their trap, for they had caught not only many wild pigs and deer but also many people. (*ibid.*).

When Lumawig looked down from the sky he saw that his sons had flooded the Earth, and he noticed that there was just one place which was not covered. And he also saw that all of the people on the Earth had been drowned except one brother and sister who lived in Pokis. Lumawig then descended to Earth, and found the boy and girl alive but very cold. So he commanded his dog and deer to get fire for the boy and girl. The dog and the deer swam quickly away, but though Lumawig waited a long time they did not return, and all the time the boy and girl were growing colder and colder.

Finally, Lumawig went in search of the dog and the deer, and upon finding them scolded them for taking so long with their task. The dog and the deer then took the fire and started to swim through the flood, but when they had gone only a little way the fire went out. Lumawig told them to get more fire, but after they had swum only a little way once again the fire carried by the deer went out. The same things would also have happened to the fire carried by the dog, had Lumawig not gone quickly and taken it.

As soon as Lumawig reached Pokis he built a big fire and the frozen brother and sister soon warmed up. Then when the water across the Earth evaporated, the landscape included mountains and valleys.

Subsequently, the brother and sister married and had children, and thus there came to be many people on the Earth.

4.2.4 The Sun and the Moon

One day the Moon, a woman named Kabigat, was making a large copper pot. The copper was still soft and pliable like clay, and the woman squatted on the ground with the heavy pot against her knees while she patted and shaped it.

While she was working a son of Chalchal, the Sun, came by and stopped to watch her mould the form. Against the inside of the jar she pressed a stone, while on the outside with a wooden paddle dripping with water she pounded and slapped until she had worked down the bulges and formed a smooth surface.

The boy

> … was greatly interested in seeing the jar grow larger, more beautiful, and smoother with each stroke, and he stood still for some time. Suddenly the Moon looked up and saw him watching her. Instantly she struck him with her paddle, cutting off his head. (*ibid.*).

Now the Sun was not near, but he knew as soon as the Moon had cut off his son's head. Hurrying to the spot, he put the boy's head back on, and he was alive again. Then the Sun said to the Moon: "You cut off my son's head, and because you did this ever after on the earth people will cut off each other's heads." (*ibid.*). This was seen as the origin of head-hunting among the Igorot.

In *Balatik*, Ambrosio provides additional Igorot information about the Sun, which to most ethnic groups was seen as their most powerful deity (Torres and Dela Cruz, 2021: 72). Jenks (1905: 189) noticed that the Benguet Igorots recognized this by tattooing images of the Sun on their hands.

4.3 The Tagalog

4.3.1 Introduction

The Tagalog currently number at around 30 million, and are concentrated in lowland areas of central and southern Luzon (Figure

4), their 'cultural heartland' being the Philippines' capital, Manila. The word Tagalog is derived from the words 'taga' and 'ilog', meaning 'people living along the riverbank'. As a result of intensive Spanish evangelizing for more than three hundred years, most Tagalog are Christians, but their astronomical beliefs include many 'traditional' pre-Spanish elements. Traditionally agriculturalists, in Spanish times some riverine Tagalog were fishermen. Nowadays the Tagalog are known for their intricate needlework and embroidery.

4.3.2 The Creation of the Earth

When the world first began there was no land, only ocean and sky, and between them was a kite (a large bird similar to a hawk). One day the bird, which had nowhere to alight, grew tired of flying around,

> … so she stirred up the sea until it threw its waters against the sky. The sky, in order to restrain the sea, showered upon it many islands until it could no longer rise, but ran back and forth. Then the sky ordered the kite to [a]light on one of the islands to build her nest, and to leave the sea and the sky in peace. (*ibid.*).

Now at this time the land breeze and the sea breeze were married, and they had a child which was a bamboo. One day when this bamboo was floating about on the water, it struck the feet of the kite which was on the beach. The bird was angry and "… pecked at the bamboo, and out of one section came a man and from the other a woman." (*ibid.*).

Then the earthquake called on all the birds and fish to decide what should be done with these two people, and it was decided that they should marry. Many children were born to the couple, and from them came all of the different races of the Earth.

After a while the parents grew very tired of having so many idle and useless children around. They wished to be rid of them, but did not know where to send them. Time went on and the children became so numerous that the parents enjoyed no peace. One day, in desperation, the father seized a stick and began beating them.

This so frightened the children that they fled in different directions and hid. Some ran into rooms in the house, where they concealed themselves in the walls or in the fireplace; some ran outside; while several fled to the sea.

Now it happened that

> … those who went into the hidden rooms of the house later became the chiefs of the Islands; and those who concealed themselves in the walls became slaves. Those who ran outside were free men; and those who hid in the fireplace became negroes; while those who fled to the sea were gone many years, and when their children came back they were the white people. (*ibid.*).

4.4 The Visayan Ethnic Groups

4.4.1 Introduction

The term 'Visayan' refers to the inhabitants of the larger islands of Samar, Leyte, Bohol, Cebu, Negros, Masbate and Panay, and the many smaller islands in this area of the central Philippines (see Figure 4). Collectively, they are a socio-linguistic group, and their Bisayan languages are closely related to the Tagalog languages of Luzon.

Visayan men were renowned mariners and warriors, and males and females were famous for their full-body tattoos (the Spanish referred to them as 'Los Pintados', i.e. 'The Painted Ones'). Now principally Roman Catholics and devoid of tattoos, they originally believed in the existence of a pantheon of gods and spirits, and that the Sun, Moon, stars and other heavenly bodies guided their lives and should be revered. Elements of their ancestral animistic belief system have been incorporated in modern religion and now form 'Folk Catholicism'.

4.4.2 The Sun and the Moon

Once upon a time the Sun and the Moon were married, and they had many children all of whom were stars. The Sun was very fond of his children, but whenever he tried to embrace any of them, he was so hot that he burned them up. This "… made the Moon so angry that finally she forbade him to touch them again, and he was greatly grieved." (*ibid.*).

One day the Moon went down to the spring to do some washing, and when she left she told the Sun that he must not touch any of their children in her absence. When she returned, however, she found that he had disobeyed her, and several of the children had perished. She was very angry, so she

> … picked up a banana tree to strike him, whereupon he threw sand in her face, and to this day you can see the dark marks on the face of the Moon. (*ibid.*).

Then the Sun started to chase her, and they have been going ever since. Sometimes "… he gets so near that he almost catches her, but she escapes, and by and by she is far ahead again." (*ibid.*).

4.5 The Bukidnon

4.5.1 Introduction

Far from the Tinguian, the Igorot and the Tagalog and to the south and east of the Visayan islands is the large island of Mindanao.

In the central part of Mindanao are the Bukidnon (see Figure 4), a timid people who, attacked from time to time by the Moro on one side and the Manobo on the other, have withdrawn into the hills. A peace-loving people, their greatest concern is for the good will of the numerous spirits who watch over their every act.

In this country "… the belief prevails that there are spirits in the stones, in the baliti trees, in the vines, the cliffs, and even the caves." (*ibid.*). And never does a man start on a journey or make a clearing on the mountain side until he has first besought these spirits not to be angry with him but to favor him with prosperity and bring good crops.

The greatest of the spirits is Diwata Magbabaya,

> … who is so awe-inspiring that his name is never mentioned above a whisper. He lives in the sky in a house made of coins, and there are no windows in this building, for if men should look upon him they would melt into water. (*ibid.*).

4.5.2 Formation of the Moon and the Stars

One day in the times when the sky was close to the ground a spinster went out to pound rice. Before she began her work, she took off the beads from around her neck and the comb from her hair, and hung them in the sky.

Then she began working,

> … and each time that she raised her pestle into the air it struck the sky. For some time she pounded the rice, and then she raised the pestle so high that it struck the sky very hard.
>
> Immediately the sky began to rise, and it went up so far that she lost her ornaments. Never did they come down, for the comb became the moon and the beads are the stars that are scattered about. (*ibid.*).

Ambrosio tells us that the Bukidnon used the Moon to measure time, with one month comprised of 15 'bright nights' and 15 'dark nights' (Torres and Dela Cruz, 2021: 97), which relate with the 'waxing' and 'waning' of the Moon.

But Ambrosio goes beyond the Moon and the stars to link the different types of objects in the sky with the ecological setting of different ethnic groups. Thus, boats, fish and fishing equipment characterize the sky of coastal groups, while

> There are hunters, hunting implements, and hunting prey among those who live in the forest like the … Bukidnon (Torres and Dela Cruz, 2021: 4).

4.5.3 Magbangal and the Planting Season

One of these Bukidnon hunters was Magbangal, and he often went to a certain hill where he killed wild pigs for food. One night as it was nearing the planting season, he sat in his house thinking. After a long time he called to his wife and told her that tomorrow he planned to go to the hill and clear land for a garden. His wife wished to accompany him, but he refused, insisting that she remained at home.

Next morning she arose early and prepared food for him, but he would not eat: "No, I do not want to eat now, but I will return this afternoon and you must have it ready for me." (*ibid.*).

Then he gathered up his ten hatchets and bolos (large knives), a sharpening stone, and a bamboo tube for water, and started for the hill. Upon reaching his land he cut some small trees to make a bench. When it was finished, he sat down on it and said to the bolos, "You bolos must sharpen yourselves on the stone." (*ibid.*). And the bolos went to the stone and were sharpened. Then he said to the hatchets: "You hatchets must be sharpened" (*ibid.*), and they also sharpened themselves. Then Magbangal said: "Now you bolos cut all the small brush under the trees, and you hatchets must cut the large trees." (*ibid.*). So the bolos and the hatchets set to work, and from his resting-place on the bench Magbangal could see the land being cleared.

Magbangal's wife was at home weaving a skirt, but she kept hearing the trees falling. She thought that her husband must have found many people to help him clear the land, and she wondered who they were. So, she left the house and walked rapidly toward the field, but as she drew nearer she proceeded more slowly, and finally stopped behind a tree. There

> From her hiding-place, she could see her husband asleep on the bench, and she could also see that the bolos and hatchets were cutting the trees with no hands to guide them. (*ibid.*).

She was amazed, thinking Magbangal very powerful as she had never before seen bolos and hatchets working by themselves. Suddenly Magbangal jumped up, and seizing a bolo he cut off one of his own arms. Then

he woke up, and sat there thinking: "Someone must be looking at me, for one of my arms is cut off." (*ibid.*). Then he saw his wife, and knew that she was the reason why he lost his arm. As they walked home together he told her that he was going to live in the sky, where he could give a sign to the people when it was time for them to plant crops, and she had to go to a stream and become a fish.

Soon after he went up into the sky and became the asterism Magbangal (part of Orion); and ever since, when the people see these stars appear in the sky, they know that it is time to plant their rice.

When Fay Cooper-Cole (1956: 123–125) interviewed the Bukidnon on 4 February 1910, apart from Magbangal they pointed out eight other asterisms. Of these, Ambrosio identified Baka as the Hyades (the jaw of the pig slain by Magbangal), Molopolo as the Pleiades (the hill where Magbangal hunts), Ta-on as his axe, Malala as his knife, Sagob-a-ton as a bamboo grinder, while Ti-ok was Magbangal's per lizard (Torres and Dela Cruz, 2021: 148).

Cooper-Cole also was able to elaborate on how Magbangal and Molopolo related to cultivation (Torres and Dela Cruz, 2021: 169):

> … the time for planting, as well as bananas, sugarcane and some varieties of rice and corn has come when the Molopolo has risen 45° in the east. On one hand, the time for cleaning the fields for the yearly planting of rice is when Magbangal is seen 45° in the sky. The weeds are burned when it has moved to the west of the zenith. Planting can begin a few days afterwards.

But alternate asterisms could be used:

> The rising of the asterism called Ta-on may also signal the time for clearing the fields when it rises 45°. The burning may be done when Ta-on is 95° in the sky (it has passed the zenith) and the asterism Ti-ok is at 55°. Planting must immediately follow these signs because the heavy rains will soon begin. (*ibid.*).

Molopolo is also a monsoonal marker. Thus, when it rises in the east this announces the arrival of the dry season, and when it appears in the west at sunset this "… means the advent of the rainy season." (Torres and Dela Cruz, 2021: 174).

4.6 The Bilaan

4.6.1 Introduction

In the hills and mountains to the west and southwest of the Gulf of Davao in the southeastern part of Mindanao (Figure 5) live the Bilaan ethnic group (also now known as the Blaan and Bila-an).

Fay-Cooper Cole (1913: 130) says it would appear that the Bilaan never encountered the Spanish and

> … are almost unknown to history, for aside from two or three short accounts, based mostly on hearsay, we find no mention of them.

The Bilaan lived in houses located near scattered clearings where they practised dry cultivation of a range of different food plants (including rice). Fay-Cooper Cole (1913: 139) mentions that "Some new clearings are cut in the jungle each year, after the constellation Balatik [Orion] has risen out of the sea." The diet of the Bilaan was supplemented by fish, deer, wild pigs, jungle fowl and other species caught in the forest, and various fruit and herbs that were collected.

The Bilaan were famous for their brassware, copperware, beadwork and weaving. They worship a Supreme Being and creator named Melu, and recognize a range of spirits, who live in the sky, on the Earth and in the underworld.

4.6.2 The Creation of the Earth and People

In the beginning there were four beings, and they lived on an island no larger than a hat that had no trees, grass or any other living thing besides these four people and one bird. One day they sent this bird out across the ocean to see what he could find, and when it returned it brought some soil, a piece of rattan and some fruit.

The greatest of the four beings was Melu, and

> … he took the soil and shaped it and beat it with a paddle in the same manner in which a woman shapes pots of clay, and when he finished he had made the earth. Then he planted the seeds from the fruit, and they grew until there was much rattan and many trees bearing fruit. (Cole, 1916).

The four beings watched the growth for a long time and were well pleased, but finally Melu said: "Of what use is this earth and all the rattan and fruit if there are no people?" (*ibid.*). The others agreed and said, "Let us make some people out of wax." (*ibid.*). So they took some wax and worked long, fashioning it into human form, but when they took them to the fire the wax melted, and they saw that men could not be made in that way.

Next they decided to try to use dirt in mak-

ing people, and Melu and one of his companions began working on that. All went well until they were ready to make the noses. The companion who was working on that part put them on upside down. Melu told him that the people would drown if he left them that way, but he refused to change them, so when his back was turned Melu

> … seized the noses, one by one, and turned them as they now are. But he was in such a hurry that he pressed his finger at the root, and it left a mark in the soft clay which you can still see on the faces of people. (*ibid.*).

Figure 5: A map showing the location of the Bilaan (yellow) and Mandaya (green) ethnic groups at the time when Mabel Cook Cole was collecting data for her book (after F.-C. Cook, 1913: Frontispiece).

4.6.3 The Creation of Men and Women

In the very beginning

> … there lived a being so large that he cannot be compared with any known thing. His name was Melu, and when he sat on the clouds, which were his home, he occupied all the space above. His teeth were pure gold, and because he was very cleanly and continually rubbed himself with his hands, his skin became pure white. (*ibid.*).

The dead skin that he rubbed off his body was placed in a pile, and became so large that it annoyed Melu, so he began thinking about what he should do with it.

Finally, he decided to make the Earth; so he worked very hard in putting the dead skin into shape, and when it was finished he was so pleased with it that he determined to make two beings like himself, though smaller, to live on the Earth.

Taking the remnants of the material left after making the Earth he fashioned two men but just as they were all finished except their noses, Tau Tana from the underworld appeared and wanted to help him. Tau Tana then made noses for the men, but he placed these on the peoples' faces upside down. When all was finished, Melu and Tau Tana whipped the forms until they came to life.

All went well until one day a great rain came,

> … and the people on the earth nearly drowned from the water which ran off their heads into their noses. Melu, from his place on the clouds, saw their danger, and he came quickly to earth and saved their lives by turning their noses the other side up. (*ibid.*).

The people were very grateful, and promised to do anything Melu should ask of them, but before he left for the sky, they told him that they were very unhappy living on Earth all alone, so

> … he told them to save all the hair from their heads and the dry skin from their bodies and the next time he came he would make them some companions. (*ibid.*).

In this way women were created, the men were happy, and eventually there were a great many people living on the Earth.

4.7 The Mandaya

4.7.1 Introduction

As Figure 5 indicates, at the time the Coles were conducting their fieldwork the Mandaya ethnic group occupied the heavily forested mountainous region from the eastern Gulf of Davao to the Pacific Ocean coast, and a parcel of mountainous land on the upper western border of the Gulf.

The Mandaya were a warlike people, and those living in different districts "… are seldom on good terms and are frequently in open warfare with one another or with neighboring tribes." (Cole, 1913). In all the Philippines the Mandaya were the foremost artisans in working iron and silver, the former mainly for knives and daggers and the latter for ornaments.

Like the Bilaan, the Mandaya grew rice

and other crops in clearings in the forest, and

> About November first, when a group of seven stars called *poyo poyo* [The Pleiades] appears in the west, it is a signal for all who expect to clear new land to begin their labors. By December first this constellation rises straight above and it is then time to plant. This is further confirmed by the appearance of a star known as *sabak*. If any have delayed their planting until the middle of December they are given a last warning when the stars forming *Bayatik* [Orion] appear. (Cole, 1913).

Notwithstanding these cultivated foods, a considerable proportion of the diet relied on hunting and gathering in the forest. Most common were birds, deer, pigs and fish, and a variety of plant foods.

4.7.2 The Creation of Men and Women

In the very early days before there were any people on the Earth, the limokon (a kind of dove) were very powerful and could talk like men even though they looked like birds.

> One limokon laid two eggs,
>
> … one at the mouth of the Mayo River and one farther up its course. After some time these eggs hatched, and the one at the mouth of the river became a man, while the other became a woman. (*ibid.*).

The man lived alone on the bank of the river for a long time, but he was very lonely and wished many times for a companion. One day while crossing the river something swept against his legs with such force that it nearly caused him to drown. Upon examining it, he found that it was a hair, and he decided to go up the river and find out where it came from. So,

> He traveled up the stream, looking on both banks, until finally he found the woman, and he was very happy to think that at last he could have a companion.
>
> They were married and had many children, who are the Mandaya still living along the Mayo River. (*ibid.*).

4.7.3 The Sun, the Moon and the Stars

The Sun and the Moon were married, but the Sun was very ugly and liked to argue. One day he became angry at the Moon and started chasing her. She ran very fast until she was some distance ahead of him, then she grew tired and he almost caught her. Ever since he can be seen chasing her, at times almost reaching her, and at other times falling far behind.

The first child of the Sun and Moon was a large star, and he was like a man. At one time

> … the Sun became angry at the star, cut him up into small pieces and scattered him over the whole sky just as a woman scatters rice, and ever since there have been many stars. (*ibid.*).

Another child of the Sun and Moon was a gigantic crab. He still lives and is so powerful that every time he opens and closes his eyes there is a flash of lightning. Most of the time he lives in a large hole in the bottom of the ocean, and when he is there we have high tide. When he leaves the hole the water rushes in and there is a low tide. His moving about also causes great waves on the surface of the ocean.

The crab is quarrelsome—just like his father—and he sometimes becomes so angry with his mother, the Moon, that he tries to swallow her. People on the Earth are fond of the Moon, and when they see the crab near her they run outdoors and shout and beat on gongs until he is frightened away, thereby saving the Moon.

In his monograph of *The Wild Tribes of Davao District, Mindanao* Fay-Cooper Cole (1913) explains that to the Mandaya phases of the Moon were "… caused by her putting on or taking off her garments. When the moon is full she is thought to be entirely naked."

4.8 Summary

The foregoing accounts show the different stories, legends, and myths about stars and heavenly bodies contained in Mabel Cook Cole's *Philippine Folk Tales*, plus information provided in Ambrosio's *Balatik*. Most common are the stories about the creation or beginning of the Earth and its human inhabitants. Gods and Goddesses were included in these creation stories and constantly interfered with the lives of the people on the Earth. The second most common stories relate to the Sun and the Moon. Often they are a quarreling couple, and usually end up chasing each other across the sky.

While all of these astronomical folk tales relate to ethnic groups of the Philippines, Cole (1916) reminds us that many of these stories "… are held in common by all the tribes of the Archipelago and even by the people of Borneo, Java, Sumatra, and India." This is discussed by Rahmann (1955). The ways in which we can account for these commonalities are explored in Section 5.4 below, but only after we have compared and contrasted the different versions that are found

across the Philippines, discussed the nature of the Tinguian 'sky world', and explored the possibility that some of the foregoing 'folk tales' may have been inspired by one or more witnessed meteorite impacts

5 DISCUSSION

5.1 *Philippine Folk Tales*: The Nature of The Evidence

All of the creation stories in *Philippine Folk Tales* differ significantly. In the Igorot version there was an already existing Earth that was governed by a Great Being who created men and women, but in the Tagalog's creation story there was just the sky and the water, and no mention of a Great Being who was involved in the development of the Earth; man, meanwhile, came out of bamboo. The Bilaan also had a Supreme Being, who with three collaborators created men and women to inhabit the Earth, while with the nearby Mandaya it was a bird that laid two eggs, one hatching as a man and the other a woman.

The folk tales about the Sun and Moon also differ. From the Tinguian stories we find that the Sun is male and the Moon female, but they are not married to each other. We also learn that when they were quarrelling the Sun threw sand on the Moon's face and this is how the *maria* on the Moon were formed.

In the Igorot story the Sun is also male and the Moon female, and again they are not married to each other. Nor were they quarrelling, but this story does explain the origin of the Igorot penchant for head-hunting.

The Visayan folk tale has the Sun and Moon male and female respectively, and married to each other. They have many children who are the stars, and while the Moon was absent the Sun tried to embrace some of them and they were burnt up. When the Moon discovered this, she attempted to attack her husband, who threw sand in her face. As with the Tinguian, this explains the origin of the lunar maria. After this, the Sun liked to chase his wife across the sky, sometimes almost catching her.

Meanwhile, the Mandaya also recognize the Sun and Moon as male as female, and married to each other. But the Sun is quarrelsome, and as with the Visayan liked to chase his wife across the sky, sometimes almost catching her. In this folk tale (and the parallel Visayan one) there is no mention of what happens on those occasions when he does catch her and an eclipse occurs. Instead we are told about one of the Moon's children, a giant crab, who is quarrelsome just like his father and sometimes gets angry with his mother and attempts to eat her. The Mandaya react in the standard way found throughout SE Asia when a dragon or serpent tries to devour the Moon by rushing outdoors and creating a great deal of noise in the hope of driving away the predator. However, the Mandaya version, involving a giant crab as the Moon's very own offspring, is unique. It is interesting, too, that this crab is associated with the tides, and what appear to be tsunamis. All that is missing is the suggestion that his movement on the floor of the ocean may sometimes also create the earthquakes that give rise to these tsunamis.

Sadly, there are other aspects of solar and lunar astronomy about which Mabel Cook Cole's book is silent. For instance, there is no mention of the progressive change in the appearance of the Moon, as she goes through the different phases from New Moon to Full Moon and back to New Moon. Nor are lunar occultations of stars and planets mentioned, even though twenty to thirty of these would have been visible in any one year. For such astronomical detail, and the Moon's calendrical role and as a monsoonal marker, we must rely on accounts in Ambrosio's *Balatik* (see Torres and Dela Cruz, 2021).

Specific astronomical information other than about the Sun and Moon is sparse in Mabel Cook Cole's *Philippine Folk Tales*, although we do learn that the Bukidnon referred to part of Orion as 'Magbangal', whereas it was usually known as 'Balatik' elsewhere in the Philippines (*ibid.*). And from the Bukidnon we also learn that it was beads from a woman's necklace that became stars in the sky, while to the Mandaya stars were formed when the Sun got angry with his first born, a large star, and cut him into little pieces and scattered these across the sky. Meanwhile, the Visayan folk tales have the stars as the very numerous offspring of the Sun and Moon. Yet these are generalisations, and apart from the reference to Magbangal there is no discussion of individual asterisms. But fortunately *Balatik* comes to the rescue with abundant information of different stars and asterism, and the critical role that some of these played in Philippine human ecology (*ibid.*).

5.2 The Philippine Sky World

As has been well documented in many cultures around the world (e.g. see Hamacher et al., 2022), *Philippine Folk Tales* reveals that what is valued here on the Earth is sometimes projected into the sky, so that there is a direct correspondence between the 'Earth World'

and the 'Sky World'. Thus, through the Tinguian account of Aponibolinayen and Ini-init we learn that in Ini-init's 'Sky World' he lives in a house, near a stream where he catches fish daily, which he eats with rice (although we must assume that he does not cultivate the rice as he spends all his daylight hours in the sky). At his house he boils his fish in a pot over a fire. Near his house is a spring, where women collect water, and there are betel nut trees. Both on Earth and in the Sky World oiled betel nuts were used as messengers. Sadly, we are told nothing about Ini-init's appearance, such as whether he sometimes displays facial or bodily blemishes that we might identify with 'sunspots'.

That said, it is telling that in the following Tinguian story of Gaygayoma and Aponitolau, there is no sugarcane field in the sky world, and in order to quench her desire Gaygayoma has to raid Aponitolau's field down on Earth. But without this literary license, there would have been no grounds for developing the folk tale about Gaygayoma and Aponitolau.

5.3 *Philippine Folk Tales* and Meteorite Impacts

There are two possible meteorite analogues in the Tinguian folk tale about Aponibolinayen and Ini-init. Firstly, when Aponibolinayen accompanies Ini-init into the sky and melts he places her in a bottle, surrounded by blankets and pillows, and drops her down to Earth—shades of a meteorite impact. Secondly, when Ini-init subsequently comes down to the Earth to attend a ceremony hosted by Aponibolinayen's parents, he is seen to assume the form of a round stone (reminiscent of a meteorite that has just landed on the Earth). Could both elements in this folk tale have been inspired by an actual meteorite impact that was witnessed by the Tinguian? If so, this event may have occurred sometime after the initial Spanish arrival in the Philippines archipelago, given that blankets, pillows and bottles are all post-contact cultural elements.

Pursuing this thread further, there is another possible reference to a meteorite impact in *Philippine Folk Tales*, again associated with the Tinguians. This is the story of Gaygayoma, the beautiful daughter of the Moon and a star, and the sugarcane field of Aponitolau (the name now assigned to Ini-init). Aponitolau was concerned that someone had been raiding his sugarcane field so one evening he lay in wait and eventually saw "… many stars falling from the sky, and … Suddenly a star so large that it looked like a flame of fire fell into the field …" This was Gaygayoma. This whole episode could have been inspired by a witnessed stony meteorite impact where the meteoroid disintegrated above the Earth's surface showering an elliptical area (known as the strewn field) with predominantly small meteorites, and in this particular case one large one represented by Gaygayoma. Alternatively, the "… many stars falling from the sky …" could have been inspired by a particularly impressive meteor shower, or a totally unforgettable Leonid Meteor Storm (see Dick, 1998).

Astronomers and geologists have yet to systematically research Philippine meteorites, and until this occurs and a coordinated 'national meteorite search' is implemented the number of known meteorites may remain at just the five listed in the Meteoritical Society Bulletin database (see Valdueza and Orchiston, 2015).[4] These are shown in Table 1 and plotted in Figure 6. It is interesting that the Paitan Meteorite locality is about 125 km SSW of Tinguian territory, and in 1910 when this meteorite fell, the Tinguians would definitely have seen the bolide *if* the sky was clear at the time.

In this context, when future ethnoastronomical fieldwork is carried out among the Agta negrito ethnic group from the southern end of their distribution in Luzon, it will be important to check if there is any event in their astronomical legends that we may be able correlate with the impact of the Bondoc Meteorite. At 888.6 kg, this rare mesosiderite is by far the most massive meteorite known to have landed in the Philippines (see Table 1), and its impact in the heavily forested mountains of the Bondoc Peninsula would have been a wonderous event. Sadly for Filipinos, after the meteorite was discovered by locals in 1956 it was purchased by Dr H.H. Nininger, the famous American meteorite collector and

Table 1: Officially recognized Philippine meteorites, listed in alphabetic order by name.

Official Name and Type	Provence, Region or Island	Type of Meteorite	Mass	Discovery Year
Bondoc (find)	Quezon Province	Stony-Iron, Mesosiderite	888.6 kg	1956
Calivo (now known as Kalibo) (fall)	Panay	Stony, Achondrite	2.4 kg	1916
Paitan (fall)	Ilocos	Stony, H6	516 g	1910
Pampanga (fall)	Central Luzon	Stony, L5	10.5 kg	1859
Pantar (fall)	Central Mindanao	Stony, H5	2.13 kg	1938

Figure 6: Geographical distribution of known Philippine meteorites (map: Wayne Orchiston).

researcher, and is now in the Meteorite Museum at Arizona State University (Valdueza and Orchiston, 2015).

5.4 The Latest Multidisciplinary Evidence and Possible Dating of Folk Tales in Mabel Cook Cole's Book

There are three distinctive types of evidence that we can use to try and date some of the folk tales in Mabel Cook Cole's book and associate them with specific ethnic groups.

Firstly, we can examine the range of non-local flora and fauna mentioned, with their respective introductions into the Philippines region providing the earliest possible dates for certain folk tales. Secondly, we can look for parallel folk tales or legends in other parts of SE Asia (and beyond). Thirdly, using genetic evidence (mainly mitochondrial DNA) we can see if it is possible to link the folk tales to the arrival of specific socio-linguistic or ethnic groups in the archipelago.

In the various folk tales discussed in this paper we find mention of the banana, rice and sugar cane, as well as two commensals, the dog and the chicken. There is now clear evidence of the origins of these flora and fauna and when they first reached the Philippines, and we summarise these data in Table 2. This indicates that most of the current versions of the folk tales in Mabel Cook Cole's book date within the past 5000 years. In non-literate indigenous societies around the world the transfer of knowledge by word-of-mouth over this length of time is well attested. For example, the Aboriginal Australians have oral records of meteorite impacts associated with known craters (Hamacher and Norris 2009), while coastal groups from Australia recall the end phase of the last post-glacial sea level rise. Beginning around 22,000 years ago sea levels world-wide were about 125 meters below their present levels, and they then rose relentlessly, only to establish the present-day coastline of Australia around 6000 years ago (Nunn and Reid, 2016).

Apart from the flora and fauna listed in Table 2, we know from the folk tales that the Igorot also used pottery. The earliest pottery found in northern Luzon dates to around 2500 BP (Mijares, 2007). This provides the earliest possible date for the origin of the *current* version of the associated Igorot folk tale.

Throughout *Philippine Folk Tales* Cole (1916) comments on the instances where the legends she is recounting, or components of them, are found elsewhere. For example, in the northern Luzon account of Aponibolinayen and Ini-init, the use of a vine to draw a human up into the Sky World is also found in Malaysia, Polynesia and North America (Cole, 1916, 8n), while Aponibolinayen's magical stick that creates fish is found among the nearby Ilocano and Igorot ethnic groups of the Philippines, and further afield in Borneo, Java and India (Cole, 1916, 9n). Meanwhile, accounts similar to Aponibolinayen melting and turning into oil are also found in Borneo and Malaysia (Cole, 1916: 17n). At the other end of the Philippine archipelago, Mindanao, the giant crab of the Mandaya of Mindanao is also found in Malaysia and on the Philippine

Table 2: Introduced flora and fauna mentioned in *Philippine Folk Tales*.

Common and Scientific Name	Most Likely Source	Arrival Date in Philippines (BP)[4]	Ethnic Group in Cole's Book	Reference
Banana (*Musa* spp.)	New Guinea	>4000	Visayan	Denham (2011)
Rice (*Oryza sativa japonicus*)	Taiwan	~3240	Bukidnon; Tinguian	Snow et al. (1986)
Sugar Cane (*Saccharum* spp.)	New Guinea	~4500	Tinguian	Denham (2011)
Dog (*Canis lupus familiaris*)	Taiwan	2500	Tinguian; Igorot	Amano et al. (2013)
Rooster (*Gallus gallus*)	Mainland SE Asia	>5000	Tinguian	Storey et al (2010)

island of Palawan, near Borneo (Cole, 1916: 93n), while the Bilaan creation story is replicated in Borneo (Cole, 1916: 105n).

Until comparatively recently it was relatively easy to identify the foregoing folklore elements with successive waves of hominids that occupied the Philippine region: either the original *Homo sapiens*, referred to as the Australo-Melanesians and now represented by the negrito populations of Luzon, Mindoro, Palawan, Panay, Negros and Mindanao, who first settled this region 70,000–60,000 years ago, or the Austronesians, who first arrived in northern Luzon from Taiwan around 4000 years ago and then spread throughout the archipelago and southwards into Borneo and the eastern half of present-day Indonesia (see Orchiston et al., 2021: 52–66). The Austronesians were seen as adept mariners, who arrived in Luzon with rice, pottery, pigs and dogs (Bellwood, 2017). Then about 1000 years later another wave of migrants, termed the Austro-Asiatics, entered SE Asia from southern China, via Vietnam and Thailand, and spread through the Malay Peninsula, into Borneo and across Java and the Greater and Lesser Sunda Islands of Indonesia (where they encountered Austronesians). But they never settled as far north as the Philippines. This simple two-phase model drew mainly on archaeological, genetic and linguistic evidence.

In recent years, refined genetic evidence has become increasingly important in our quest to understand human evolution and the origins and movements of ethnic groups. Specifically, mitochondrial DNA (mtDNA), inherited through the maternal line,

> … has been shown as a very informative genetic marker to study the genetic diversity and generic relationship among populations in the Philippines. (Arenas et al. (2020: 1–2).

Equally informative are Y chromosome studies, which follow male genetic inheritance.

Recently Larena et al. (2021a) published a ground-breaking paper that provides a revolutionary view of Philippine prehistory based on

> … ~2.3 million genotypes from 1,028 individuals representing 115 indigenous Philippine populations and genome-sequence data from two ~8,000-y-old individuals from Liangdao in the Taiwan Strait.

Figure 7 shows the geographical distribution of the populations sampled, while Figures 8 and 9 illustrate the ways in which sea level varied during the past 75,000 years and how the landscape in the Philippine region changed dramatically as a result.

The Larena team also introduce new terminology, and they provide a time frame for the different phylogenetic developments that they identify. Thus, they envisage "Multiple migrations to the Philippines during the last 50,000 years"—which is the precise title of their paper (Larena et al., 2021a: 1)—with the earliest of these being Denisovans, extinct archaic hominids found throughout Asia during the Pleistocene (Reich et al., 2011)[5] and now believed to be a regional equivalent of Europe's Neanderthals. Genetic analyses suggest that they typically had dark skin, dark hair and brown eyes (Meyer et al., 2012).

According to Larena et al. (2021a: 2) the negritos were next to settle in the Philippines, and there were separate northern and southern negrito groups. A selection of photographs of Philippine negritos is presented in Figure 10, and we have attempted to plot the geographical distribution of the different ethnic groups in Figure 11. However, this proved a non-trivial exercise because even over the past century there have been major demographic changes.

For example, when Fay Cooper Cole and his wife were carrying out research in Mindanao they noted there was evidence that the negrito population was once far more widespread, but had been

> … partially absorbed by intermarriage with the later comers. In all the groups, except the Bilaan, the percentage of individuals showing evidences of Negrito blood increases as we go from the coasts toward the interior, until in such divisions as the Obo and Tigdapaya of the Bagobo, and the Tugauanum of the Ata, practically all the people show traces of this admixture. (Fay-Cooper Cole, 1913: 139–140).

This evidence of widespread gene-sharing is important in terms of the transfer of astronomical knowledge between human populations. Note that Cole (1913: 140) also mentions that at that time negritos were reported living on the Samal Islands in the Gulf of Davao, but because there was no evidence of them later we did not include them in Figure 11.

Note that in the course of their research, Larena et al. (2021a) included the following negrito groups: Aeta (western Luzon), Agta (from throughout eastern Luzon), Batak (Palawan), Ati (Panay), Ata (Negros) and Mamanwa (Mindanao). In addition, one of the four 'Mangyan' sampling localities on Mindoro is near the northern end of the island adjacent to the territory of the Iraya negrito group.

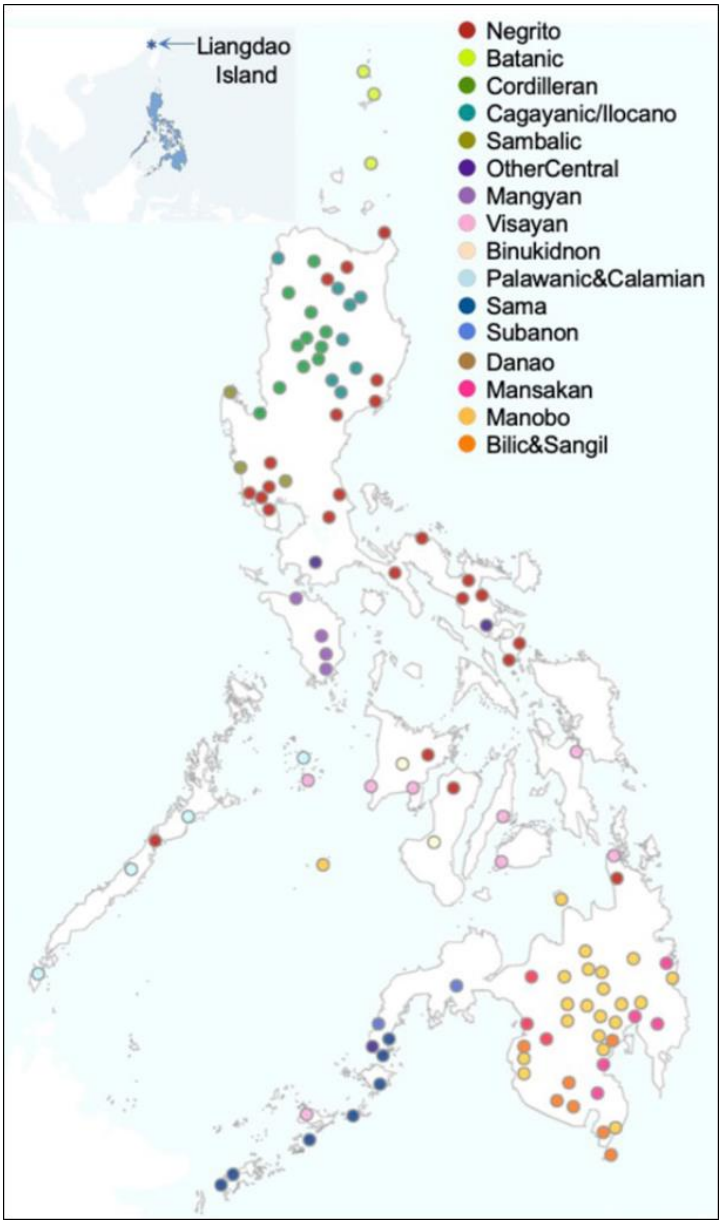


Figure 7: Map showing sampling localities (after Larena et al., 2021: 3).

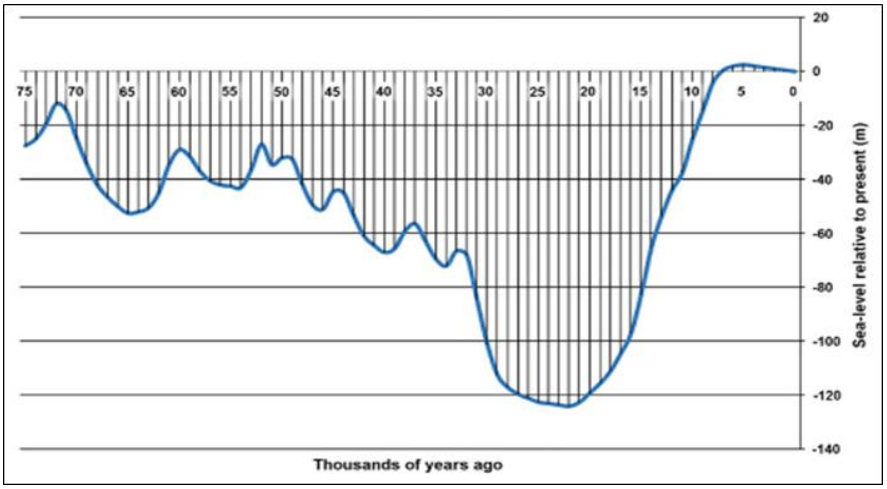


Figure 8: Sea level changes in the Philippine region during the past 75,000 years (after Kealey et al., 2017: 262).

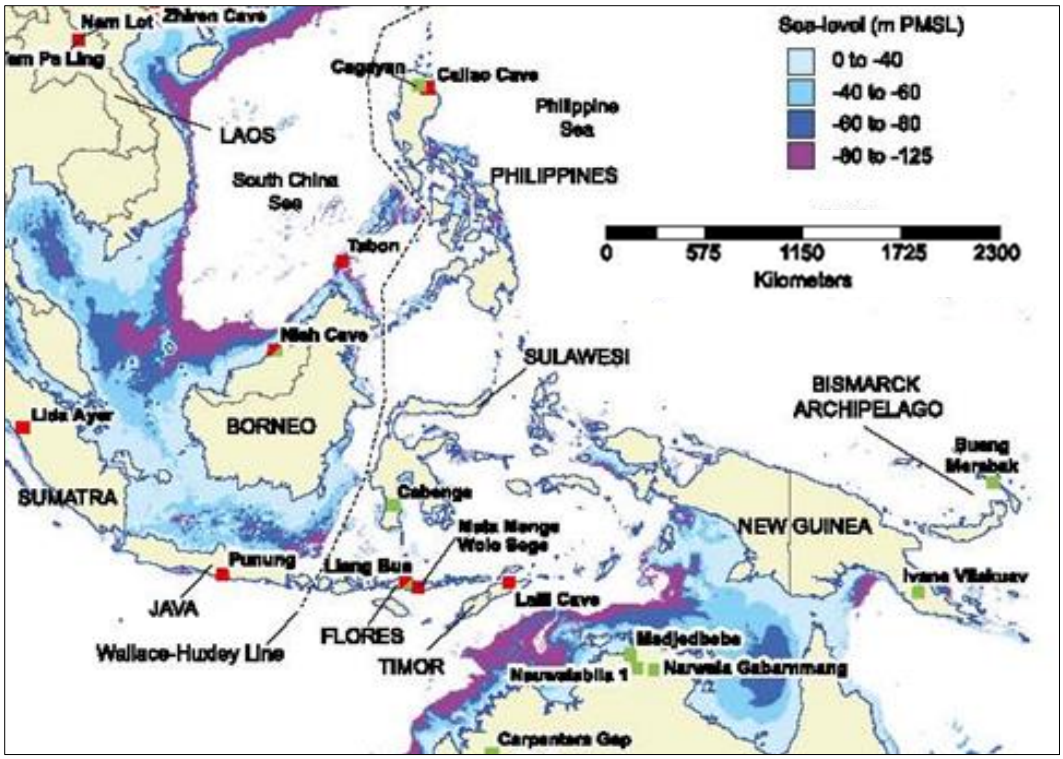


Figure 9a: A map of SE Asia showing present-day and former coastlines. At the time of the initial settlement of the Philippines by negrito groups the sea levels were close to –55m, and the coastlines were near the junction of the medium and dark blue areas. The greatly enlarged SE Asian mainland at the time of these lower sea levels is referred to as Sunda, or Sundaland—see below (map: adapted from O'Connell et al., 2018: Fig. 1).

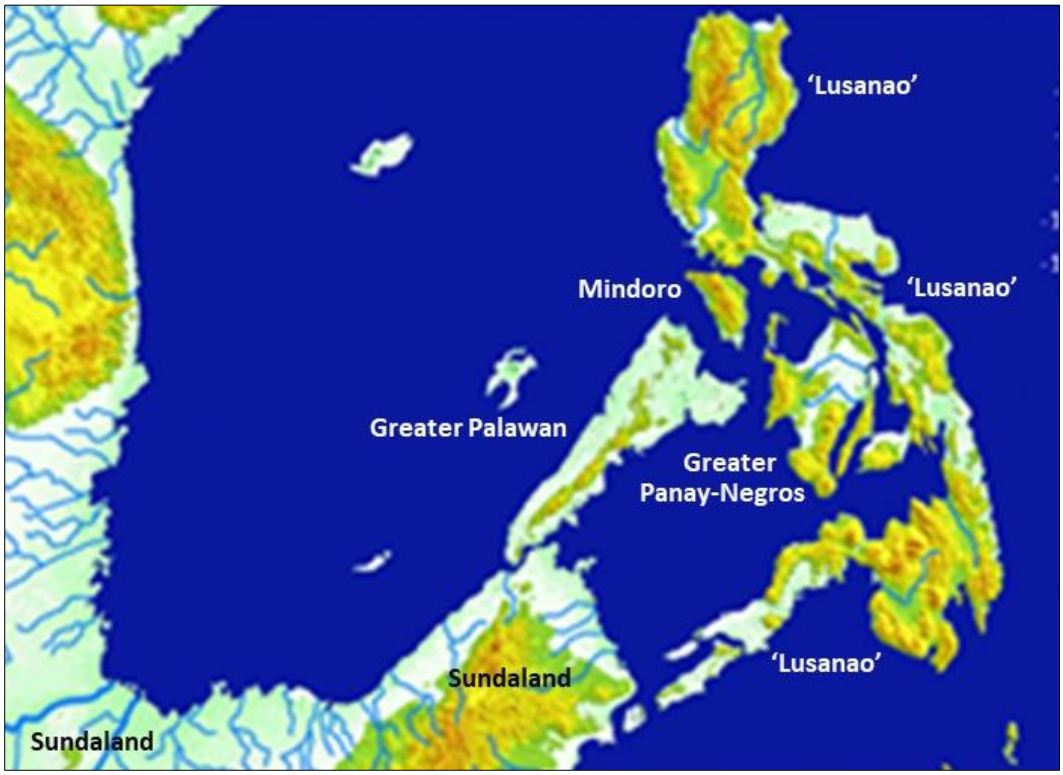


Figure 9b: A close-up of the Philippine region and adjacent Sundaland around 22,000 when the sea was at its lowest level (–125m), showing how the major islands of Luzon, Samar and Mindanao and many smaller ones were all joined, forming one long sinuous island that we refer to as 'Lusanao'. Palawan also was much enlarged, and Panay, Negros and other adjacent islands formed 'Greater Panay-Negros'. Note, however, that Lusanao and Greater Palawan were never joined directly to Sundaland, even at times of lowest sea level. Thus, in order to settle the Philippines successful water crossings always were required (map modifications: Wayne Orchiston).

Figure 10: Examples of different Philippine negritos, showing diversity of skin and hair colour and hair type. Top left: Aeta from Luzon (https://global-geography.org/af/Geography/Asia/Philippines/Pictures/Pinatubo/Aeta_Kinder_2). Top right: Batak from Palawan (https://storymaps.arcgis.com/stories/d14560bce7fa4c2b9701ef4ceee6091d). Centre: Agta from Luzon (https://www.clbxg.com/dressimage/pkooby.html). Bottom left: Mamanwa from Mindanao (http://mamanwa.blogspot.com/2007/). Bottom right: Iraya from Mindoro (https://www.ayalafoundation.org/a-young-iraya-mangyan-woman-beads-her-way-to-her-dreams/).

Larena et al. (2021a) found that the northern negritos entered the Philippines ~46,000 BP, while the southern branch arrived ~37,000 BP. Both negrito groups separated from a Basal Australasian ancestral group in Sundaland.[5]

The northern branch comprised ancestors of the Aeta, a subsection of which by around 37,000 years ago had evolved into what are now the Agta. Meanwhile, the northern negritos interbred with local Denisovans, which explains why the Aeta negritos are now known to possess the highest levels of Denisovan ancestry of any living group on the Earth (Larena et al., 2021b).

The ancestors of the Aeta are thought to have reached Luzon from Sundaland via Palawan and Mindoro, when sea levels were ~50m lower than at present (see Figures 8 and 9), but challenging water-crossings were still required between the SE Asian 'mainland' and Greater Palawan, from there to Mindoro, and finally from Mindoro to the expanded Luzon mainland.

What Larena et al. (2021a) do not do is expound on the relationships between the Batak, Iraya, Aeta and Agta northern negrito groups, although Jinam et al. (2017) found the Batak genetically more closely aligned to the Agta than the Aeta (see Figure 12), and Scholes et al. (2011: Figure 4) had also found this during their study of negrito Y chromosomes. However, Hudjashov et al. (2018: Figure 1c) were able to clearly differentiate the Batak from the Aeta/Agta (combined) using Principal Components Analysis.

Larena et al. (2021a: 2) reported that they had detected " … deep population structure … " within the Northern negritos, which separated into three clusters: the Aeta, and two Agta and groups, from near the northern and the southern ends of their extended geographical range. This is something that was pivotal to our forecast that

> … studies of the Aeta and the Agta will reveal regionally-discrete astronomical systems, given the geographical spread of both ethnic groups, but especially the Agta … (Orchiston et al., 2021: 83).

In a seminal study, Delfin et al. (2011) had earlier analysed Y chromosome variation in 390 individuals drawn from 16 Philippine ethnic groups, including six negritos: Aeta (Zambales), Aeta (Bataan), Agta, Iraya, Ati and Mamanwa. They found notable genetic differences between the different negrito groups, even between the two Aeta groups (see Figure 13), and confirmed this heterogeneity in a subsequent mtDNA study of the

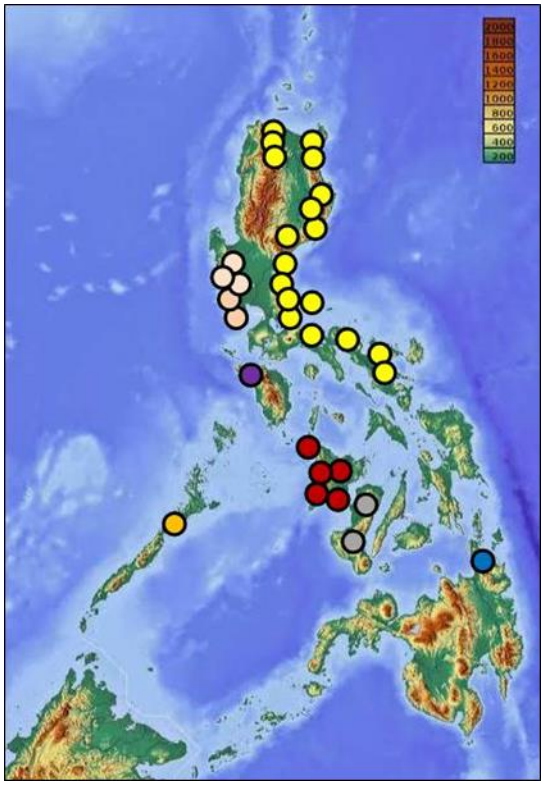


Figure 11: The geographical distribution of the main Philippine negrito groups: Aeta = pink; Agta = yellow; Ata = grey; Ati = red; Batak = orange; Iraya = purple; Mamanwa = blue (map: Wayne Orchiston).

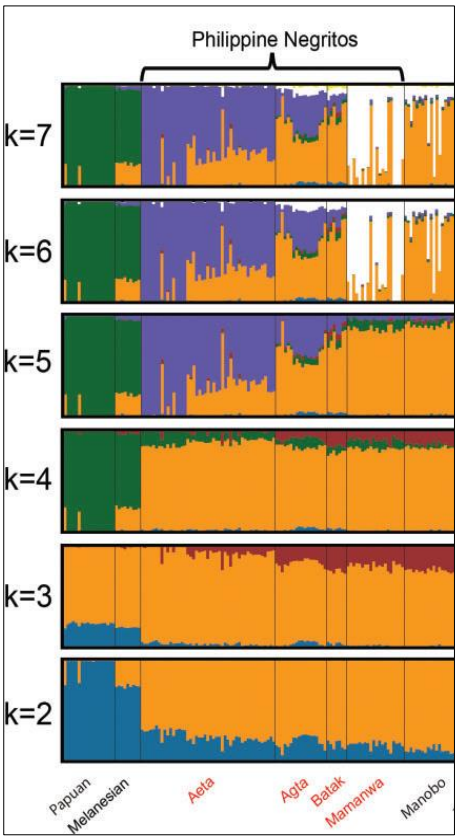
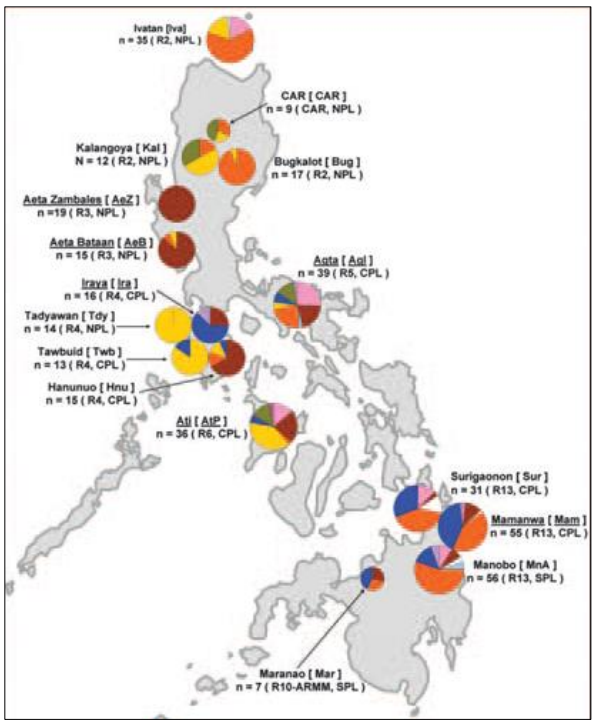


Figure 12: Genetic signatures of the following negrito groups: Aeta, Agta, Batak and Mamanwa (adapted from Jinam et al., 2017: 2017).



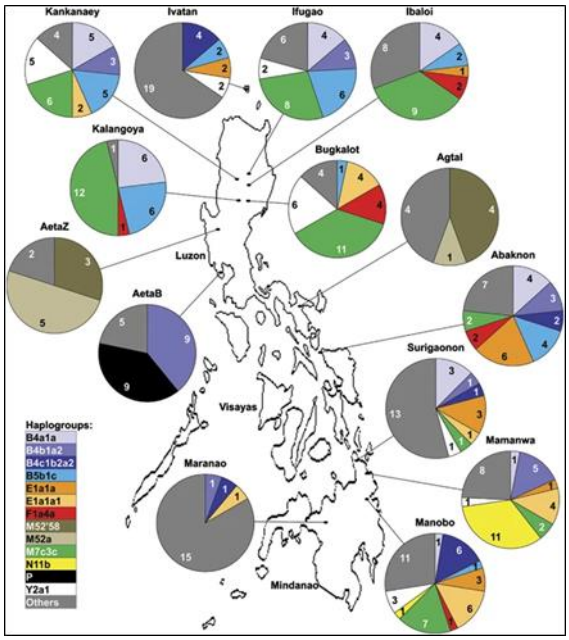


Figure 13 (left): The genetic heterogeneity of various Philippine indigenous groups based on Y chromosome data (after Delfin et al., 2011: 225).

Figure 14 (right): The genetic heterogeneity of various Philippine indigenous groups based on mtDNA data. Note, especially, the three different pie-charts for the Aeta and Agta (after Delfin et al., 2014: 232).

the same Aeta groups (Figure 14). Meanwhile, Heyer et al. (2013) confirmed this intra-ethnic group heterogeneity when they conducted Y chromosome and mtDNA studies of just four different groups, two Aeta and two Agta. They found

> … a high level of autosomal differentiation, combined with no significant reduction in diversity, consistent with long-term settlement of the Luzon region by the ancestors of the Agta and Aeta followed by reduced gene flow between these two ethnolinguisitic groups. (Heyer et al., 2013: 189).

Elsewhere we concluded that "This reduced gene flow between the Aeta and Agta groups is understandable if they were physically isolated from one another …" (Orchiston et al., 2021: 74).

Larena et al. (2021a) do not provide information about subsequent contacts once the Batak, Iraya, Aeta and Agta were safely ensconced in Greater Palawan, Mindoro and on Luzon, whereas Scholes et al. (2011: 69) specifically examined this aspect. They studied 33 non-negritos and 134 Batak negritos (from three different settlements) and found that

> … the Batak share the majority of their mtDNA and Y-chromosome variation with geographically proximate non-Negritos and with other Philippine Negritos. We find that, although the Batak still harbor some distinctive mtDNA and Y-chromosome clades, they have undergone an extensive degree of recent admixture. (Scholes et al., 2011: 63)

Let us now focus our attention on the southern negrito groups of the Philippines. The ancestors of the Mamanwa are thought to have reached Mindanao from Sundaland via the Greater Sulu Islands when sea levels were ~58m lower than at present (see Figures 8 and 9), but there were still major water-crossings that had to be made. Larena et al., (2021a: 2) found that the Mamanwa negritos had a distinctly higher Australo-Papuan-like genetic signal than the northern Luzon negritos "… and appeared as an out-group to the Papuans and Australians …" However, they were not able to totally dismiss the possibility that *all* Philippine negritos entered the country as a single migrant group, through just the one port of entry and subsequently evolved into the northern and southern groups. That said, as we have seen in Figures 12–14 the Mamanwa are genetically very different from any of the northern negritos.

Larena et al. (2021a) are silent on the genetic relationships between the Mamanwa and their negrito neighbours, the Ata and the Ati (who at one time coexisted on a single enlarged Greater Panay-Negros Island), but in their Y chromosome study Delfin et al. (2011) show that the Mamanwa and the Ati have very different genetic signatures (see Figure 13), with the Ati experiencing sub-

stantial gene-sharing with later Austronesian settlers. Meanwhile, it is now too late to compare the Ati or the Mamanwa with the Ata negritos from Negros as by the 1950s only a handful of them remained (Rahmann and Maceba, 1955). Thus, it is important to investigate the astronomical systems of the extant indigenous groups on Negros that shared genes with the negrito population that once was there.

Back in 2011 Gunnarsdóttir et al. (2011) published a paper about the Mamanwa. Apart from studying 39 Mamanwa, they also studied two Mindanao Austronesian ethnic groups, the Manobo (*N* = 44) and the Surigaonons (*N* = 26). In light of Fay Cooper Cole's comments, it is not surprising that the mtDNA haplogroup frequencies for the three different ethnic groups shown in Figure 15 indicate extensive gene-sharing. That said, Gunnarsdóttir et al. also discovered the presence of two novel haplogroups in the three ethnic groups, which they provisionally designated M* and N*. The latter haplogroup is of special interest: it was found in 1 Manobo and 14 Mamanwa (where it accounted for 36% of all mtDNA sequences). The authors then estimated the divergence time for the N* haplogroup as 55,000 to 60,000 years ago,

> … implying that the ancestors of the Mamanwa may have become isolated from the ancestors of the other Filipino groups at about this time. (Gunnarsdóttir et al., 2011: 8).

In their study of negrito and non-negrito. Philippines ethnic groups Lipson et al. (2014) provide an innovative way of representing the genetic signatures and degrees of gene-mixing by using colour-coding. Thus, the relative contributions of negrito and Austronesian genes are coloured red and blue respectively on the 'ancestry bars' in Figure 16, where all Philippine negrito groups are asterisked. This shows that at a basic level all negrito groups sampled contain evidence of gene-mixing, most intensively in the case of the Aeta and least so with the Araya from Mindoro (cf. Figure 13). Note that the Ati and Mamanwa have similar overall percentages of negrito and Austronesian genes—even though very different genetic signatures—and are comparable with those of the Agta who were located near the southern end of their extended territorial range.

Larena et al. (2021: 3) noted that some time after the Mamanwa were established on Mindanao they "… received an additional gene flow from Papuan-related populations after Australian-Papuan divergence." They provide no information about the dating of this event, but if it was associated with the transfer of the banana and sugar cane to the Philippines then it most likely took place between 4500 and 4000 BP (see Table 2). Note, incidentally, that Figure 16 does not have sufficient resolution to include the Papuan (Melanesian) genetic component that Larena et al. identified in the Mamanwa.

Another unique and surprising finding of the Larena collaboration was that

> … ethnic groups of the southern Philippines exhibit a ubiquitous ancestry that is non–AustraloPapuan-related and which is generally absent among non-Negrito groups of the northern Philippines. This unique genetic signature, heretofore designated as "Manoboancestry," is highest

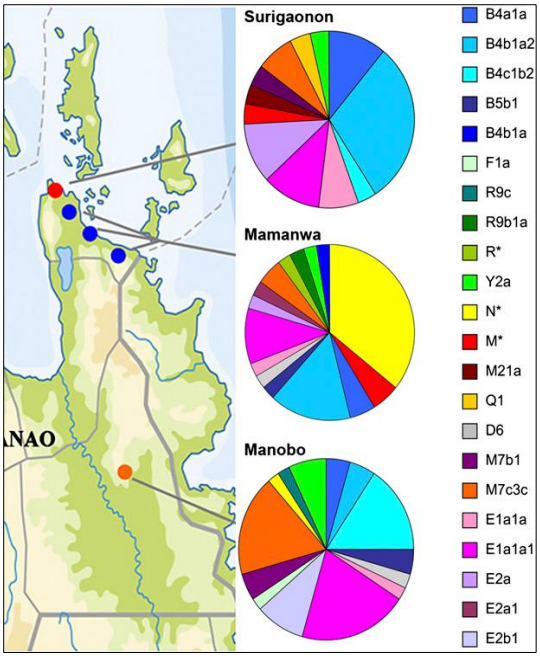


Figure 15: A map showing sampling locations, and mtDNA haplogroup frequencies, for the three Filipino groups (after Gunnarsdóttir et al., 2011: Figure 3).

> among inland Manobo groups of Mindanao Island … When we masked Cordilleran and Southern Negrito ancestry and retained only the Manobo ancestry, the Manobo component became more apparent among other ethnic groups of Mindanao … (Larena et al., 2021a: 3–4).

This is reflected in Figures 14 and 15.

Another unexpected finding of the Larena team was the existence of what they refer to as 'Sama ancestry'. These people were mostly found on the southern tip of Mindanao, on the Sulu and Tawi-Tawi Islands, and even on Palawan. Their genetic signatures were strongest among the 'Sama sea nomads' of the Sulu Archipelago, and were affiliated with Austroasiatic-speaking ethnic

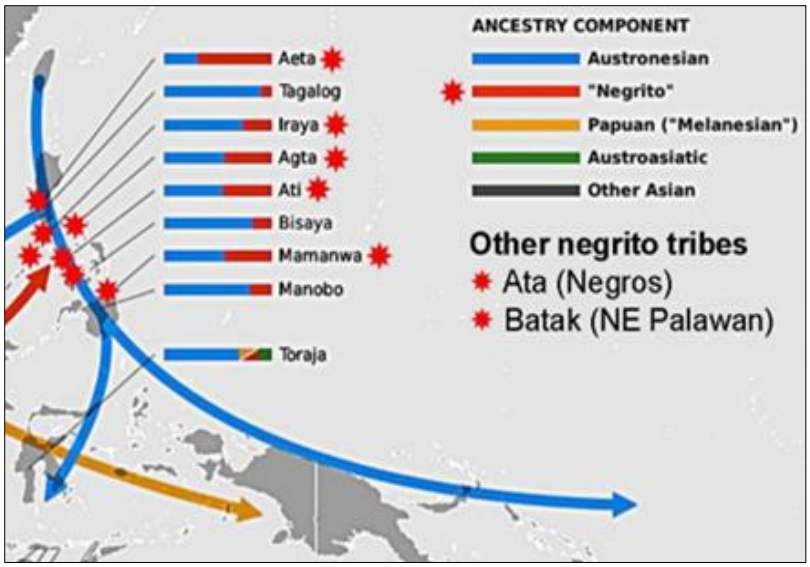


Figure 16: A map showing the genetic signatures of Philippines negrito and non-negrito groups (base map: Lipson et al., 2014: Figure 2 (cropped); major map modifications: Wayne Orchiston).

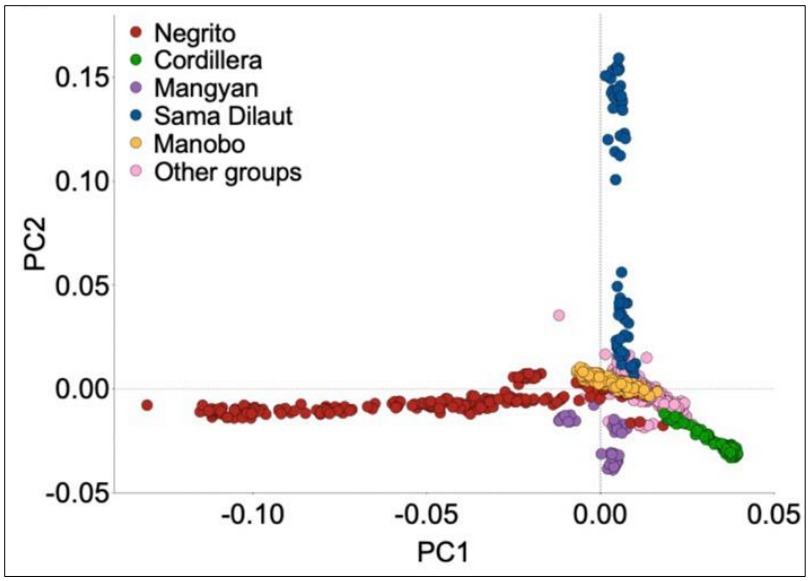


Figure 17: CPA of Philippine negrito and non-negrito ethnic groups (after Larena et al., 2021: 3).

ethnic groups (see Kusama et al., 2017). Previously it was thought that this genetic signal was only found in western Indonesia, but this was one of the possibilities that we listed when discussing Mindanao astronomical systems (Orchiston et al., 2021: 95).

Yet Larena et al. (2021a) go further and date the emergence of both the Manobo and Sama genetic ancestries at around 15,000 BP, a time when SE Asia was experiencing a rapid rise in sea level (see Figure 8) and concomitant loss of territory and familiar marine habitats (see Figure 9). Larena et al. (2021: 5) also found it interesting that Manobo and Sama ethnic groups

> … likely expanded into western Indonesia and the southwestern Philippines, via Sundaland, before the expansion of Cordilleran-related populations …

In order to genetically differentiate all of the aforementioned ethnic groups, Larena et al. (2021a: 2) carried out a Principal Component Analysis (PCA), which revealed (Figure 17)

> … a dichotomy between AustraloPapuan -related Negritos vs. non-Negritos, subsequent clustering of non-Negritos into Cordilleran vs. MSEA-affiliated [mainland SE Asian] populations, and stratification of Negritos into Ayta [= Aeta] and Agta groups and non-Negritos into Cordilleran,

> Mangyan, Manobo, and Sama-related populations.

We have now reached the end of the Pleistocene hominid settlement of the Philippines as portrayed by Larena et al. (2021a), and it is a far far more complex saga than the solitary occupation by Australo-Melanesians 60,000–70,000 BP, whose descendants are the present-day negrito populations. Instead we have original occupation by Denisovans, then by the northern negritos, the southern ne-gritos, and a succession of different ethnic groups from Sundaland, culminating in the arrival of the Manobo and Sama at a time of major environmental change. The arrival times of these various ethnic groups span from 46,000 to 15,000 BP.

What of the Austronesians and the 'Out of Taiwan' model. Does that survive Larena et al.'s investigation, or is this, too, nothing more than a gross over-simplification?

The clue has already been given with the introduction of the term 'Cordillerans'. These are a group of neighbouring ethnic groups (including the Tinguian and the Igorot) found in the central landlocked Cordilleran Mountain Range in northern central Luzon. Larena et al. (2021a: 5) make the crucial observation that the Cordillerans were

> … the only ethnic groups within the Philippines who did not receive gene flow from Negritos … This is unexpected, given the series of migrations and periods of colonization in the surrounding area of the Cordillera region and the documented records of trade and historical interactions with Negrito and non-Negrito groups of Luzon …

This genetic isolation of the Cordilleran groups is well documented by Kusuma et al. (2017), as shown in Figure 18. Here the signature of the Igorot comprises almost exclusively Austronesian genes (represented by the yellow colour), only a small component of which is shown for the neighbouring Aeta. Incidentally, this diagram also highlights the basic genetic differences between the Aeta and the Batak negrito populations, even though both belong to the northern negrito 'genetic pool'.

Larena et al. (2021: 6) also were able to date the arrival of the Cordilleran populations in the Philippines:

> Our analyses indicate that, after Negrito, Manobo, and Samalike northward migrations, gene flow of Cordilleran-related ancestry from the Southern China/Taiwan area into the Philippines may have occurred in multiple pulses after ~10 kya.

These multiple pulses are reflected in the fact that Lerena et al. (*ibid*.) did not observe

> … a north-to-south gradient of chronology for Negrito/Papuan–Cordilleran admixture … which would be expected in a simplistic and stepwise unidirectional movement of Cordilleran-related ancestry from Luzon to Mindanao. On the contrary, the oldest dates for Negrito/Papuan –Cordilleran admixture are scattered throughout the archipelago, indicating a complex nonuniform movement of populations from a putative South China/Taiwan source area into the Philippines.

Furthermore, it is apparent that the Cordillerans were hunter-gatherers, not farmers. The archaeological evidence shows clearly that 5000 to 7000-yr old coastal communities in Vietnam and south China were hunter-gatherers and fishermen (Hung, 2019). For the subsequent spread of rice cultivation in mainland and island SE Asia see Gutaker et al. (2020) and Ma et al., (2020).

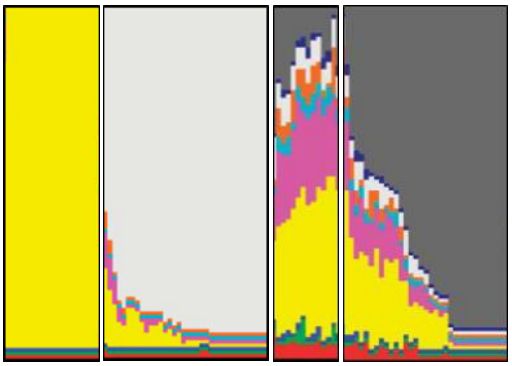


Figure 18: Genetic signatures, left to right, of the of the Igorot, Aeta, Tagbanwa and the Batak (based on a cropped and rearranged version of Kusuma et al., 2017: Figure 3).

This scenario differs markedly from Bellwood's widely-publicised 'Out of Taiwan' model for the origin of the Austronesians (see Bellwood and Dizon, 2008), which seemed to be supported by the early genetic evidence (e.g. see Ko et al., 2014; Mörseburg et al., 2016; Tabbada et al., 2010; Trejaut, 2014). But, even then, some prehistorians were uncomfortable about the mismatch between the genetic and the archaeological evidence, pointing out that none of the early supposedly Austronesian sites in the Philippines had pigs, dogs, pottery or evidence of rice cultivation (e.g. see Bulbeck, 2008; Spriggs, 2000), and that the appearance of agriculture came much later (Barker and Richards, 2013). Instead, as we have seen, Larena et al. (2021: 2) identified Cordillerans from near-coastal mainland China as the primary terminal Pleistocene –early Holocene settlers of the Philippines.

So what of the Austronesians? Is there

room to accommodate them within the new model proposed by Larena et al. (2021)—which, after all, is based on far more extensive genetic evidence than any of the previous Philippine-related studies? The Austronesians are a linguistically-based concept, but can we correlate them with any of the ethnic groups documented through mtDNA studies?

Barker and Richards (2013: 260) point out that

> Various authors … have argued that … haplogroup B4a1a … is a marker for the Austronesian expansion …
>
> Haplogroup B4a1 most likely originated c. 20000 BP on the Asian mainland, but its descendant lineage B4a1a is restricted to ISEA [island SE Asia] and points east. It dispersed across ISEA c. 8000 BP and was already present in the Bismarck Archipelago, northeast of New Guinea, by c. 7000 BP, finally dispersing into the Remote Pacific c. 3000 BP…

If we accept this explanation, which appears sensible, then it was one or more of those early pulses of settlement from China and/or Taiwan to northern Luzon early in the Holocene that introduced an Austronesian language to the Philippines, in response to the flooding of Sundaland during the sea level rise following the Last Glacial Maximum (Barker and Richards, 2013). That said, Blench (2012b) decries

> … the tendency to turn linguistic constructs into people, cultures and archaeological horizons, [and] he concludes that the Austronesian phenomenon in ISEA is more likely to have been an extended cultural process—'Austronenianisation' in his terms—[rather] than a single demographic event. (Barker and Richards, 2013: 274).

Armed with this up-dated overview of the Pleistocene–Holocene settlement of the Philippines what can we conclude about the origin of the various astronomical folk tales published by Mabel Cook Cole?

The oldest folk tales discussed by Mabel Cook Cole have to be the Tinguian accounts of Aponibolinayen and Ini-init, which originally must have been part of the Ancestral Asian Mainland astronomical knowledge base and date back more than 50,000 years since use of a vine to haul someone up to the Sky World is found (later) in North America while use of a stick to create fish is found in India. Moreover, within SE Asian we also find these legends in Malaysia, Borneo and Java, while in northern Luzon the fish-stick legend is shared by the Tinguian and neighbouring Igorot, both of which are Cordilleran ethnic groups. Meanwhile, the story where someone melts and turns into oil is also found in Malaysia and Borneo. This indicates that these three legends were current in Sundaland prior to the initial occupation of Luzon by the northern negritos around 46,000 BP. However, there is no evidence that these legends came to the Philippines with the negritos, and it is more likely that they arrived in northern Luzon with one of the Cordilleran pulses of settlement during the early Holocene. This would explain the presence of the 'fish-stick legend' among the Tinguian *and* the Igorot, while transfer of the 'vine legend' shortly thereafter to the incoming Austronesians would also explain the subsequent appearance of that legend in Polynesia. Meanwhile, mention of rice cultivation also shows this legend was modified locally, in the Philippines, within the past 3200 years in order to accommodate this dietary innovation. Furthermore, we see that the story about Aponibolinayen melting and turning into oil is a post-Spanish contact embellishment of this earlier legend, given that she took blankets and pillows with her when she went up into the sky.

We know from anthropological studies that cultures evolve, and so too do myths and legends. We see this with the Tinguian legend about Aponitolau, Aponibolinayen and Gaygayoma, where Ini-init has a new name, (Aponitolau) and is living down on Earth with Aponibolinayen instead of up in the sky. During the legend Aponitolau also acquires a second son. The presence of sugar cane cultivation reveals that this particular legend cannot be more than 4500 years old, and we suggest that it evolved *in situ* from earlier Aponitolau-Aponibolinayen legends that were shared by the northern Luzon Cordilleran ethnic groups and that it was not newly-introduced from southern China or Taiwan.

The final Tinguian legend we wish to discuss is about the sick woman named Dayapan. We suggest that this is a new legend that was developed locally in northern Luzon within the last 2500 years, given the mention of rice cultivation, sugar cane *and* a domesticcated dog and a rooster (see Table 2).

We believe that all three Igorot legends presented here also were developed locally, and within the past 2200 years, given the mention of pottery-making, a domesticated dog and copper-working.

Meanwhile, the solitary Visayan legend about the Sun and the Moon must be old, as variants of it also are found among Malaysian and Andaman Island negrito groups (Rah-

mann, 1955). It therefore was part of the Ancestral Asian Mainland astronomical knowledge base and may have been brought to the Philippines by the Southern negritos around 37,000 BP. However, this legend must have enjoyed great longevity, for it also is found among various Austroasiatic-speaking Munda ethnic groups in India, who are thought to have come from mainland SE Asia and settled in northeastern and eastern India between 6000 and 4000 BP (Arunkumar et al., 2015). Meanwhile, the Visayan version of this legend recorded by Mabel Cook Cole cannot date back more than 4000 years, given the mention of a banana tree. It is not clear as to which Visayan ethnic group this legend relates.

Of the various legends from Mindanao presented in this paper the Mandaya story about the giant crab is the oldest. Since it is also found in Borneo and among the Batak negritos on Palawan, it must relate to the ancestral astronomical system found in Sundaland prior to the negrito settlement of the Philippines. It would have arrived in the archipelago any time between 46,000 and 37,000 years ago, with either the northern or the southern negrito migrants, or even with both. However, this legend also contains a much later local Mindanao embellishment in that it mentions the scattering of rice. So the version of the legend published by Mabel Cook Cole dates within the last 3300 years.

Rice cultivation also is mentioned in the Budiknon legend "Magbangal and the Planting Season", but we have not been able to find a reliable date for the introduction of rice-growing in Mindanao. Gutaker et al. (2020) show conclusively that of the two varieties of rice found in SE Asia, it was *Oryza sativa* subsp. *japonica* from China, not *Oryza sativa* subsp. *indica* from India, that spread to the Philippines. The earliest record of rice in the Philippine archaeological record comes from the Andarayan site in northern Luzon, and dates to 3240 ± 160 BP (Snow et al., 1986), but not everyone is convinced that the carbonised remains document the local cultivation of rice at this time.

6 CONCLUDING REMARKS

Folklore, myths and legends offer one unusual way of investigating the astronomical knowledge base of indigenous societies around the world. In this paper we reviewed astronomical legends reported by Mabel Cook Cole (1916) in *Philippine Folk Tales*, supplemented by relevant material included in Ambrosio's Balatik (see Torres and Dela Cruz, 2021). While astronomical folk tales came from throughout the Philippines, most of those that we examined were from two Cordillean groups in northern Luzon and from three groups in Mindanao. Over the years, members of all five ethnic groups resisted attempts to convert them to Christianity and were known to have retained their traditional religious and astronomical beliefs.

Most of these astronomical beliefs revolved around the Sun, Moon and stars, and the formation of the Earth and the creation of the first humans. We noted that some of these legends were also found in India, the Malay Peninsula, and in Borneo and Java, and by examining the genetic evidence for the sequential settlement of the Philippine archipelago by different ethnic groups we were able to identify the most ancient legends, and show how they changed with the passage of time. This was a timely reminder that as indigenous cultures evolve and change—for a variety of reasons—so, too, do their astronomical systems (e.g. see Orchiston and Orchiston, 2016; 2018; 2021b; 2022). In fact,

> Changing astronomical systems were the norm, and our present ethnoastronomical studies are biased: they merely sample one point in time, and record a 'static' system. (Orchiston and Orchiston, 2021a).

In addition, we discuss aspects of two different Tinguian legends that we suggest may have been inspired by a witnessed meteorite impact. Upon noting the geographical distribution of officially recognized Philippine meteorites, we suggested that it is important when conducting field studies among the Agta negritos living near the southern end of their range to see if there is any possible reference to the fall of the Bondoc mesosiderite (see Figure 6). And if the impact of this meteorite occurred within the past 37,000 years (which is highly likely given that it was a surface find) it is also worth checking with the Araya of Mindoro and the Ati of Panay. In the same context, Aeta and Agta oral histories should be checked for any reference to the impact of the Paitan (1910) and Pampanga (1859) Meteorites, while the Ati would also have witnessed the arrival of the Calivo Meteorite (1916) on Panay and the Mamanwa and other Mindanao ethnic groups the fall of the Pantar Meteorite (in 1938). Have any of these witnessed falls been incorporated into the astronomical knowledge systems of the different ethnic groups?

Apart from highlighting possible research on meteoritics, this paper also flags the importance of dating the introduction and subsequent development of rice cultivation

throughout the Philippines, and the ways in which this fundamental change from a basal nomadic hunter-gatherer ecology to sedentary agriculture impacted on evolving astronomical systems.

We hope that this paper will help cultivate greater ethnographic and astronomical awareness among Filipinos, particularly the younger members of society, and that it will inspire studies not only of relevant data included in Spanish records, but also field studies of specific ethnic groups, following the guidelines provided here and in the paper by Orchiston et al. (2021), building on the pioneering ethnoastronomical research of the late Dante Ambrosio (see Torres and Dela Cruz, 2021).[6] Note that in this paper we made a point of providing an overview of Philippine environmental change and prehistory during the Late Pleistocene and the Holocene on the understanding that this can be used as an interpretive framework for future ethnoastronomical research studies.

Finally, we must not forget that this is a 'special time' for Philippine ethnoastronomy, with virtually endless research projects beckoning. But acculturation proceeds apace, so we must take advantage of current opportunities and never lose sight of our SEAAN History and Heritage Working Group motto, inspired by the immortal Elvis Presley: "It's Now or Never". Tomorrow may be too late!

7 NOTES

1. But see Cano (2008) for shortcomings of this major work.
2. Fay-Cooper Cole arranged later expeditions to Malaya, Borneo, Sumatra and Java, and wrote a further book about Tanguian culture. Subsequently, he joined the University of Chicago where he became a full Professor, and served as the Chairman of the Department of Anthropology from 1929 to 1947. With his death, in 1961, the American

   > … anthropological profession lost another one of its major figures. He was not only a world authority on the peoples and cultures of Malaysia, and one of the founders of modern archeology, but also a great administrator and developer of men and institutions and a warm and friendly human being. During his long career, which spanned more than half a century, he was in addition one of our foremost interpreters of anthropology to the general public … (Eggan, 1963: 641).

3. *Philippine Folk Tales* is available as an ebook through Project Gutenberg, at www.gutenberg.org.
4. We note that the meteorite reported to have impacted on the grounds of Negros Occidental High School in Bacolod City, Negros, on 4 June 2021 is not yet listed in the Meteoritic Bulletin Database (MBD). Although media accounts showed what appeared to be a stony or a stony-iron meteorite and it was identified by a geologist, we have yet to locate any publication that includes a formal identification and geological description of it. Only if this occurs will the object be entered in the MDB, assigned an official name, and formally accepted as a new Philippine meteorite.
5. We need to explain some geological and archaeological terms that are used in this paper. 'BP' (= 'Before the Present'), which is rather similar to 'years ago', except that by international definition the 'Present' is the year 1950 (not this year, 2022). Geological time, for the period discussed in this paper, is covered by two epochs, the Pleistocene (from 2.58 million years BP to 11,700 BP) and the Holocene (from 11,700 BP to the present day). The Pleistocene has Early, Middle and Late stages, with the Late Pleistocene from 126,000 to 11,700 BP (Gibbard et al., 2010). Sometimes it is convenient to express these dates as 126 kyr BP and 11.7 kyr BP, while the Pleistocene began at 2.58 myr BP. Note that some authors use ka and ma *in lieu* of kyr and myr.
6. This study is in sympathy with the policy of the Government's Commission on Higher Education to encourage university research into indigenous knowledge systems (De Vera, 2019). It also adds to the literature about astronomy in the Philippines and provides new material that the Government's National Historical Commission can use in developing its cultural preservation policies and the Department of Astronomy at the National Museum can utilise in planning new exhibitions and its schools and outreach education programs.

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Wayne has been very active in the IAU for several decades, and was responsible for founding the Transits of Venus and Historic Radio Astronomy Working Groups. Currently he is the Immediate Past President of Commission C3 (History of Astronomy), is on the Executive Committee of the International Conference on Oriental Astronomy, and is the Chairperson of the SE Asian Astronomy Network Working Group on History & Heritage. In 1998 Wayne co-founded the *Journal of Astronomical History and Heritage*, and is the current Managing Editor. He is also an Editor of Springer's Historical and Cultural Astronomy Series. In 2013 the IAU named minor planet 48471 'Orchiston' after him, and he and his former PhD student, Stella Cottam, received the HAD/AAS 2019 Donald E. Osterbrock Prize for their 2015 book *Eclipses, Transits, and Comets of the Nineteenth Century: How America's Perception of the Skies Changed.*

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She has written research papers on astronomy, astrobiology, astronomy education and astrophysics, and co-authored a major paper on Philippine history of astronomy and ethnoastronomy. She also is an author of books in the fields of Earth Science, Earth and Life, and Physical Science. Rose Ann has attended international training programs and seminars on astronomy education, exo-planets, astrophysics and ethnoastronomy, and she has presented research papers at local, national and international research forums. She also supervises senior high and undergraduate student research projects.

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Starting as an Assistant Instructor at RTU in 1978, Dr Torres rapidly rose through the ranks, becoming a full Professor in 1986, and became Vice President of RTU that same year and President in 2010. In 2018 he became President of the Technological University of the Philippines.

Professor Torres has taught one hundred and twenty-five different subjects at Tertiary, Masters and

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He is one of only five Filipinos who are members of the IAU, and is a member of Commission C3 (History of Astronomy). Professor Torres has written 23 volumes of researches and texts on Astronomy, is the co-author of a major paper on the Philippine history of astronomy and ethnoastronomy, and in 2021 he and Rubi-Ann Dela Cruz co-edited an English edition of Ambrosio's classic, *Balatik*. Apart from astronomy, Professor Torres has written books on Philosophy, Political Theory and Filipino Psychology, and published papers in the *Astronomy Education Review*. In 2007 he received the Padre Faura Award from the Philippine Astronomical Society, the highest award for Astronomy in the Philippines. He has attended SEAAN History & Heritage conferences and a NARIT/UNESCO ethnoastronomy workshop, and has a special interest in the history of astronomy in the Philippines.

Professor Torres is a member of the National Research Council of the Philippines in the Division of Earth and Space Sciences (Division XII), and has served on many different Philippine national committees. In 2009, he also was a member of the DOST-National Organizing Committee for the International Year of Astronomy. On 28 January 2016 he was given the Highest Distinction of Leadership Excellence in Education Asia by the Asian Council of Leaders, Administrators, Deans and Educators in Business (ACLADEB).

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