

Genetic, Linguistic and Molecular Anthropological Study of the Indian Ocean Littoral in Austronesian Dispersal Across the Pacific

Banrida T Langstieh

Professor & Head Department of Anthropology, North-Eastern Hill University, Shillong Meghalaya, India

ABSTRACT

The Indian Ocean region is a critical route/corridor/barrier for the migration and settlement of people whose social, linguistic and genetic ancestry is of interest to anthropologists worldwide. Varying from the 'little tradition' of small isolated populations to the 'great tradition' of global and admixed heritage, in the field of collating evidences from culture, language and anthropological genetics this paper will examine the 'Austronesian dispersal' within the boundaries of the Indian ocean sporadically sprinkled across Pacific islanders. Littoral or near shore settlements may have simply act as 'gateways' as would have been the case with pre-historic settlements somewhere near a fresh water source or river bank. Physical environmental changes such as those driven by drastic ecological catastrophes including severe and acute adaptations to climatic and nutritional stressors can leave signatures providing vital clues for the dispersal of humankind.

During the last two decades or more, a plethora of genomic information has surfaced tracing the genetic history of an archaic hominin group from ancient DNA. In the light of ensuing works by palaeoanthropologists and evolutionary biologists, the dispersal and migration of people, genes and languages studying human history either directly through their remains or indirectly through tools, pottery or other cultural items have provided concerns over interpretation of archaeological dates. Similarly assessing the reliability of linguistic data which may favour a close correlation between genes and languages, yet at times appear to conflict with genetic evidence.

Despite these limitations, several ideas has been put forth concerning the dispersal of modern humans from Africa via the southern route, along the coast of India, eventually reaching Sahul the landmass consisting of Australia and New Guinea, which were connected until rising sea levels separated them about 8000 years ago. This putative "early southern dispersal", as it came to be known, would now be underwater. From single versus multiple dispersal models molecular anthropologists have re-examined hypotheses about the colonization of the Pacific with different pliable approaches to understand population histories in the context of the 'Austronesian dispersal' across the Pacific.

*Corresponding author

Banrida T Langstieh, Professor & Head Department of Anthropology, North-Eastern Hill University, Shillong Meghalaya, India.

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Introduction

Somewhere down the line in the quest of corroborating scientific research developments in genetics and its ever-upgrading technology whatsoever with queries and interpretations on our understanding of dispersal of the humankind, I shall present here a collection of research findings which were put forth during these last two decades or so, with an update from where I had left off while pursuing my research interest in molecular anthropology.

In today's age and time, even for an anthropologist we rely on trying to detect physical evidences from the visible or un-visible elements in nature; from atoms and molecules; genes and genomic, living, dead or decayed biological matter including cultural artifacts which can provide vital clues and be given utmost importance in the most scientific of laboratory analysis and data interpretation. Not to mention that with the rapidly evolving tools and techniques of research in molecular biology, genetics,

archaeology and/or linguistics or in any scientific field of research and development the applications of STEM Science, Technology, Engineering and Medical Sciences cannot be ignored.

As for the relevance of the Genetic, linguistic and molecular anthropological study of the Indian Ocean Littoral, in Austronesian dispersal, across the Pacific, I would like to address and be specific in collating the reviewed information on post-genomic era that is, research publications available in these past two decades or more with an over lay of the classical findings on archaeological and linguistic research.

Genetic

Evolutionary Theories & Practical Applications

Our contemporary understanding of evolutionary processes builds on theory developed during the "Evolutionary Synthesis" of the 1930s-1940s when Darwin's ideas especially "Natural Selection" were joined with Mendelian Genetics. Continuing elaboration with discoveries in molecular genetics has helped us understand the genetic changes that are often reflected notably in population genetic studies on phenotypic and/or genotypic variation. From

an anthropological geneticist's perspective, what we understand today is that any changes in genetic variation originate by mutation and/or by recombination of DNA sequences albeit in any form of bio-chemical protein substances. Compilation of these genetic variation studies quantitative and qualitative traits has helped guide us to understand the nuances of polymorphism, heritability, genetic mapping, drift, selection, admixture or gene flow within and among populations. The use of DNA sequence data theoretically to act as "molecular clock" accumulating substitutions over the course of timeless generations, "calibrating" and recalibrating based on geologically dated events such as fossils of studied lineages or the separation of two landmasses on which related phylogenetic taxa resides or the calculations based on nucleotide substitutions some of which maybe neutral mutations molecular evolution, provide a basis for many important references. For example, inferring effective population size, time of the most recent ancestor TMRCA, historical relationships of populations, divergence and genetic polymorphism of advantageous as well as detrimental genes related to health, heritable diseases, human adaptation and many more.

Academically, combining micro level field observations within a macro level framework, the study of small-scale movement within a particular habitat dispersal and longer distance directional movements from one habitat to another migration have led to our understanding that no doubt the human species arose in Africa, but then what happened to the trails of human dispersal beyond the vast oceans. The Indian Ocean region for that matter would it be called a critical route/corridor/barrier for the migration and settlement of people whose social, linguistic and genetic ancestry subsumes a varied characterization of socio-cultural, linguistic, economic, behavioural and biologically related history of humankind in Asia and beyond. On the same lines of thought as that applied for the 'Peopling in India' with lineages mentioned for the Ancestrally North Indian ANI and Ancestrally South Indian ASI as referred by [1]. Plotted on a larger scale for the 'Pan Asian' distribution whether would it be in majority via the 'Southern Route' by water or seaways along the coastline of vast oceans or by foot on land taken by 'Northern Route' the spread of distinct ethnic identity through language and culture says it all. Figure 1

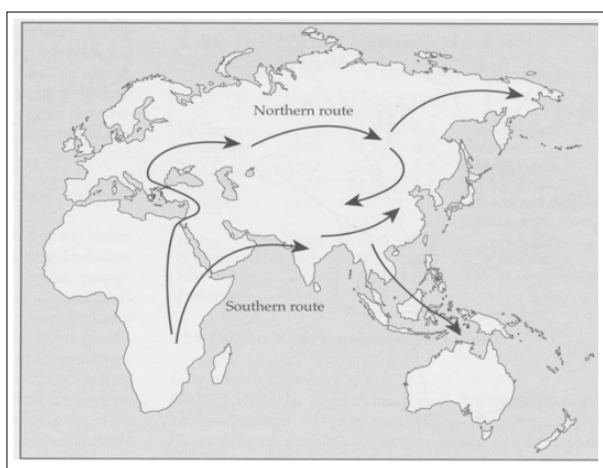


Figure 1: Two Alternative Routes for Out-of-Africa Migration [4].

Addressing these issues of population history today, we have had the opportunity to read and know and be aware that there is a plethora of good research publications generated from genetic, linguistic, archaeological, geological and not to mention anthropological data that seeks to provide updates pertinent to the interest of this region.

In global context, the magnum opus of on the "History and Geography of Human Genes" as well as its popular version of "Genes, Peoples and Languages" gave a detailed description of probable human migration by continents based on theories and corroboration with classical genetic markers Blood groups, Serum protein, enzymes, etc [2].

A Mention was Provided with a Focus on the Compilation Under the Following Themes

- The initial Out-of-Africa dispersal of modern humans
- The colonisation of the New World
- The colonisation of the Pacific

Indian Scenario

With reference to studies in India or the Indian subcontinent a reference may be made to the initiatives published by the Indian Academy of Sciences, in the Journal of Bioscience on India's fossil Biota: Current perspectives and emerging approaches [3]. A plethora of articles were compiled from multidisciplinary views by Palaeontologist, Geologist and other research working groups from the Centre for Ecological Sciences, Indian Institute of Science, Bangalore; Birbal Sahni Institute of Palaeobotany, Lucknow; IIT Kharagpur, ISI Kolkata, etc. Notable contributions by these articles discussed divergence time estimates of mammals from molecular clocks and fossils, relevance of new fossil finds from India, examining the potential of an "Out of India Hypothesis" which was put in question as to whether India was at the crossroads of human evolution?

In a previous collaborative finding by on 'The Indian Heritage' a published report from Archaeological, Linguistic and Anthropological patterns, suggests that the Indian subcontinent has been populated by a series of migrations [4].

Notable among them was the classification of four basic distinct linguistic groups in India namely, Austro-Asiatic, Indo-Aryan, Dravidian and Sino-Tibetan which is briefly summarize in the following:

- I. Austric language speakers came soon after 65,000 years BP, probably from the northeast
- II Dravidian speakers around 6,000 years BP from the mid-east with knowledge of cultivation of crops like wheat and domestication of animals like cattle, sheep and goats
- III Indo-European speakers in several waves after 4000 years BP with control over horses and knowledge of Iron technology
- IV. Sino-Tibetan speakers in several waves after 6000 years BP with knowledge of rice cultivation etc...

Thus, in the context of India with reference to linguistic evidences from theory and praxis four language families namely

1. Indo-Aryan
2. Dravidian
3. **Tibeto-Burman Trans-Himalayan group**
4. **Austro-Asiatic** are clearly identified in the context of its people. For this presentation I will be reviewing only the latter two language families and stretching towards the Pacific Islanders with glimpses and insights into the **Austronesian dispersal**.

A good sizeable number of publications has been received when in the light of multidisciplinary research collaborations, we see the names of practicing historical linguists among them for Tibeto-Burman linguistic group who would prefer to the usage of the term 'Trans-Himalayan group'. On the other hand had proposed a re-classification of the Austro-Asiatic linguistic group whereby

he identified a subclade categorizing the Khasi and Nicobarese as Southeast Asian ‘Mon Khmuic’ and not ‘Mon Khmer’ though the latter is still preferred [5,6].

On the contrary a closer examination of the Mongoloid populations in India particularly those that belonged to the Trans-himalayan linguistic group also known as the Tibeto-Burman or Sino-Tibetan groups, their affinity towards the East Asian dispersal by land is one of the most common. Though relatively dated to a much later wave of comparatively recent migratory route less than 6000 bp settled in the young fold mountains of the Himalayas, with supporting genetic evidences linked to the Asian continent. Evaluating the gene flow along the sides of the Bay-of-Bengal an extensive analysis revealed that the population history of South Asian Tibeto-Burman speakers is more complex [7]. Reported studies about the contrasting maternal and paternal genetic variation of Asian populations with increased genetic variants and/or reportedly high genetic diversity indices using Y-chromosome, mitochondrial DNA and HLA gene systems is not found uncommon [8,9].

The Austro-Asiatic Element

Being a Khasi and an Austro-Asiatic language speaker myself, I would like to look back into my PhD from Calcutta University 2004 & the subsequent post doctoral researches which is about 2 decades ago, an initiation into the molecular anthropological journey unravelled by DNA studies on the autosomal, mitochondrial and Y-Chromosomal markers [10-15]. The extension of this study on the Austro-Asiatic linguistic group had provided biological evidences or signatures of genetic lineages Y-chromosomal haplogroups and mitochondrial DNA data from India dispersing beyond the Bay of Bengal via the sea shores and coastal entry points into Southeast Asia and beyond. Of late, an updated research on the genetic legacy of Indian Austroasiatic speakers provided astating remark aboutthe eminentcontinental scale admixture for a subset of ancestral populations when map for South and Southeast Asia indicating that through Y chromosomal paternal lineages the Indian Ocean was a permeating Corridor for human population dispersal in the region with signals found extending towards the Austronesian language speakers of the Pacific [16].

In the context of Austronesian Dispersal

In line with the given topic of this presentation entitled “Genetic, linguistic and molecular anthropological study of the Indian Ocean Littoral, in Austronesian dispersal, across the Pacific” a brief knowledge showing the distribution of the various subgroups of Austronesian languages [Figure 2] Map showing Distribution of Austronesian language speakers cited from needs a special mention here. Beyond the Indian Ocean into the Pacific contains a large geographical expansion whose area coverage stretches from Madagscar in the West, Taiwan in the North, Hawaii islands in the East and New Zealand in the South [17]. Historically the South Pacific islands has also been known to be divided into regions defined partly by geography Near Oceania and Remote Oceania and culture Melanesia, Micronesia and Polynesia [Figure 3].Academicians who are interested in collating information from linguistic, archaeological and anthropological findings from Australia, Europe, Asia and the US have published quite a number of research findings particularly reporting about the estimated initial colonization of these islands, including plausible migratory routes based on radio carbon dating of shells, bone, plant materials, etc as well as the type of dentate pottery called ‘Lapita’.

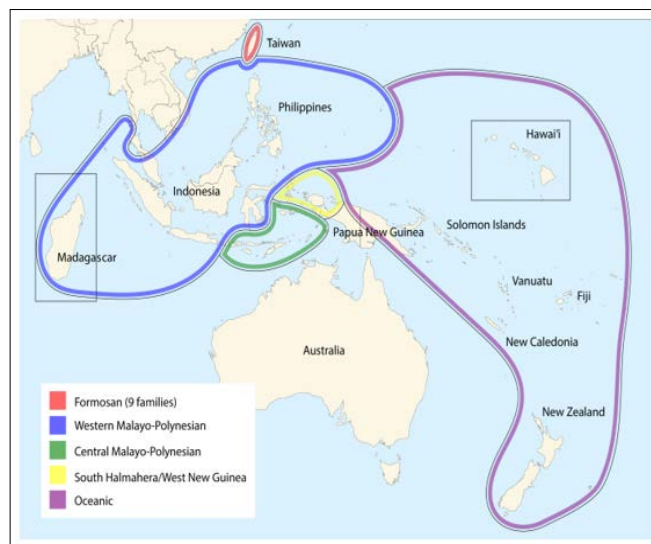


Figure 2: Map Showing Distribution of Austronesian language Speakers [17].

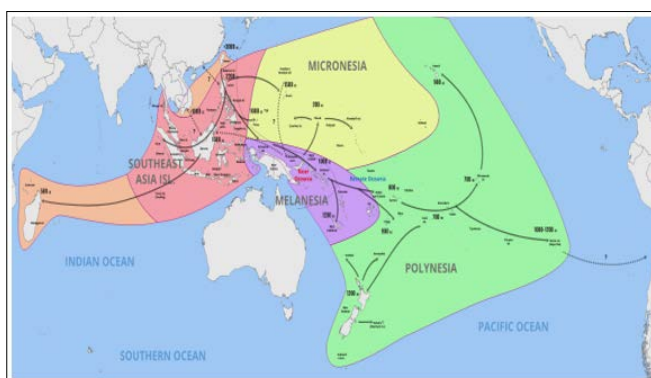


Figure 3: Chronological Dispersal of Austronesian People Across the Pacific

With respect to linguistic evidence, three identified major groups associated with the Pacific include - Australian, Papuan and Austronesian. In contrast to the Australian and Papuan languages which are extremely heterogenous groups of very divergent languages, the Austronesian languages are considered to be definitely related to one another forming a comparatively homogenous family. With the help of linguists in this field, biologist compiled and produced a tree of Austroneian languages which showed remarkable congruence with geography of near and remote Oceania [18].

Through archaeological and linguistic evidences interesting findings emerged which includes distinctive pottery and rice agriculture suggesting the proposition of interests on different migratory models affiliating Austronesiancultural and perhaps biological origin to Southeast Asia. Whether by land or by sea, below are some of the proposed models related to the Austronesian dispersal:

- (i) “Express Train” model of Jarred Diamond 2000 [19].
- (ii) “Out of Taiwan” model of Peter Bellwood 2007 [20].
- (iii) “Triple I” model of Roger Green 2010 which stands for Intrusion, Integration and Innovation emphasizing the roles of migration, admixture and new inventions [21].
- (iv) “Entangled Bank” model of John Terrell 1988 also referred to as the “Out of Melanesia” model which denies the importance of any single wave of migration for the Austronesian dispersal in Southeast Asia and Near Oceania [22].

On a similar note, a few other compilations on Anthropological Genetics published by Michael mentions of a brief historical update on theory, methods and application including human diaspora of four continents Africa, Europe, Oceania and Americas [23]. On one such issues was the reporting about the peopling of the Pacific Oceania, by who reiterated the significance of the archaeologically recognized 'Lapita Cultural Complex' and a genetic deletion of one copy of a 9 base pair bp repeat sequence in the COII/tRNA^{Lys} intergenic region, a marker generally referred to as the 'Polynesian motif' with its Asian and Non-Asian origin derivatives. Linguistic analyses have played a key role in developing models for Pacific settlement, particularly with regard to the origins of the Lapita peoples, associated with the spread of the Austronesian languages [24-26].

In this era of molecular genetic information being provided by ancestry informative markers when deciphering elements of the Mitochondrial DNA maternal, Y chromosomal DNA paternal and Autosomal DNA biparental inheritance through Genotyping, Whole Genome Sequencing with Microarray and GenoChip technologies both quantitative and qualitative data are more easily accessed today than ever before. This is made possible when one goes through publications and the ever updated data banks maintained by such research groups. For a molecular anthropologist, studying these analytical variation in mitochondrial DNA, Y-chromosome DNA and/or autosomal DNA including X chromosome either in contemporary populations or ancient specimens allows us to reexamine both the classical findings and contextualize with the current research trends on population genetic history in this field.

Evidences from the Molecule Ancient and Modern

Thus, one of the most common way to investigate questions concerning with the origin, relationships and history, structure and migration patterns of human populations is of interest to those who does research in this field. Of late, biological information of these kind helps probe studies on the ancient or archaic DNA bioengineered from human fossil remains, such as those reported cases of interest from the Neanderthal and Denisovan ancestry [27-30]. A few reported studies stretched with headline references such as - "Did archaic genetic variants help Melanesians adapt?" whereby it was reported that the DNA of Melanesian populations carries some of the largest percentage of ancestry from now-extinct Neanderthals and Denisovans [31]. Genome scientists at the University of Washington School of Medicine, were interested to discover structural changes in the DNA of modern-day Melanesians that might have been inherited from Neanderthal and Denisovan ancestors. This research team specifically focused on a structural change called copy-number variants, which occur when a large stretch of DNA sequence in the genome becomes duplicated or deleted. To this and many more such research findings from multi disciplinary fields being exercised in the past will continue to be carried forward by those who are interested in this field for future interest of this discipline.

In conclusion, such molecular anthropological insights with inferences from Archaeology and Linguistics have provided emerging trends of expanding researches in this ever growing field of interest. As living example, the Bay of Bengal region will definitely have reflections of bio-social interest whether from Prehistoric to the Protohistoric times. Palaeoanthropologists and anthropological geneticists has put forth several ideas concerning the dispersal of modern humans from Africa via the southern route, along the coast of India, eventually reaching Sahul the

landmass consisting of Australia and New Guinea, which were connected until rising sea levels separated them about 8000 years ago. This putative "early southern dispersal", as it came to be known, would now be underwater. From single versus multiple dispersal models, in these last two decades or more molecular anthropologists have also re-examined hypotheses about the colonization of the Pacific with different pliable approaches to understand population histories in the context of the 'Austronesian dispersal' across the Pacific.

In this present era how molecular clocks are refining human evolution's timeline while examining morphological and genetic connections between modern humans and other primates gets constantly updated with current research in this field. As put forth by Evolutionary while stressing the fact that we have come a long way when most people think of Anthropology in this 21st century [32]. Molecular Anthropology which have been defined as the use of molecular genetic methods to address questions and issues of anthropological interest, more specifically genetic evidences to obtain insights into human origins, migrations and population history as well as the role of natural selection during human evolution, and the impact of particular cultural practices on patterns of human genetic variation can be extended addressing population specific interests and issues related to health, disease and adaptation. All these and much more will provide key contributions on the use of such information as a vital source for comparative inferential evidence besides biomolecules on human migrations the world over [33-39].

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