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Northeast Indian Passageway as Barrier or Corridor for Human Migrations: An Evaluation through distinctiveness of Y-chromosome and Mt-DNA gene pools

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ABSTRACT: Northeast India is the homeland of different ethnic groups with a variety of cultures and speaking different languages and dialects. Though many scholars consider the region as melting pot of diverse races, castes, religions, languages and cultures; the northeast Indian passageway connecting the Indian subcontinent to East/Southeast Asia is thought to have been a major corridor for human migrations. Since it is also an important linguistic contact zone, it is predicted that northeast India has witnessed extensive population interactions, thus, leading to high genetic diversity within groups and heterogeneity among groups. To test this prediction, various scientific evidences were collected and analysed in due course of time. A review of such studies was conducted and contrary to the prediction, the results provide strong evidence for a genetic discontinuity between northeast Indian groups and other Indian groups. Therefore, it can be conclude that the northeast Indian passageway acted as a geographic barrier rather than as a corridor for human migrations between the Indian subcontinent and East/Southeast Asia, at least within the past millennia and possibly for several tens of thousands years, as suggested by the overall distinctiveness of the Indian and East Asian Y-chromosome and mt-DNA gene pools.

1. INTRODUCTION

Ethnicity stands for a group's way of conceptualising and relating to society. It welds together individuals who share a history, culture and community, who have an amalgam of language, religion and regional belonging in common and perhaps most critical of all, they feel that they come from the same stock [1]. Though the term ethnicity is of recent origin, its idea has been present since long. Its probable first use by David Reisman in 1953 only renamed an already existing and recognized phenomenon. People have identified themselves with particular cultures through processes like acculturation, integration and assimilation. Ethnic identity on the other hand is an affiliative construct, where individuals view themselves and others view them as belonging to a particular cultural group [2]. The growth of the spirit of ethnicity or ethnic self-assertion among various groups leads to the aspiration for a distinct identity for themselves.

1.1 Ethnic identity

Ethnic identity has both objective and subjective connotations. Objectively it is "primordial affinities and attachments" and subjectively it is an activated primordial consciousness" [3]. While Issacs (1975) and Greeley (1974) supported the objective concept, Geertz (1975) emphasized the latter and Van den Berghe argues in favour of combining the two [3]. The ethnic groups with a small population and low exposure to development tend to suffer from an identity crisis. The aspirations for an independent ethnic identity lead to the formation of a nation within a nation through various ways including ethnic struggles and violence.

An identity is born because of a variety of factors. Every ethnic group has its own distinct culture, language or dialect and traditional institutions. The fact of belonging to one group often gives rise to fellow feelings and sentiments. Factors like the desire to preserve one's culture and traditional institutions, preventing them from being assimilated with the dominant culture, fear of being deprived of what is one's due and exploitation of resources by outsiders make such sentiments stronger. For A. K. Baruah 2004, "identity is directly related to the emergence of an educated elite in the concerned community" [4]. In

the absence of any other major social force such an elite comes to acquire a hegemonic position in the community, perpetuates its hegemony and mobilizes the community on communal lines. H. N. Das (2004) finds factors such as a desire for self-expression, perceived discrimination and injustice, aspirations of small time politicians, better economic development of neighbouring small states responsible for the rise of sub-national and ethnic movements in Assam [5].

1.2 Conflict situation

The stronger groups being unable or unwilling or both often do not take cognizance of even the legitimate needs and aspirations of weaker ethnic groups [6]. Such intolerance and imperviousness lead to the growth of a feeling of discrimination and alienation on the part of smaller group. The dominant group possesses a tendency to brand all group aspirations and demands as anti-national or secessionist without going into their merits or demerits. The smaller groups get lost in the process of forced assimilation in the name of accommodation and integration. This gives rise to the desire for self-expression and an identity separate from that of the dominant groups [5].

1.3 Human migration

Modern human evolution is punctuated with migrations that ultimately led our ancestors to spread over most parts of the world within the past 100,000 years [7, 8]. Migration routes are influenced by landscape and, consequently, natural passageways acting as corridors played a key-role in the history of human migrations, as exemplified by the Nile River Valley, which connects Africa and Eurasia [9], central Asia, which connects west and east Eurasia [10, 11, 12], and eastern Indonesia, which connects Southeast Asia and Australia/Oceania [13].

1.4 Northeast Indian Passageway

The northeastern tip of India, flanked in the north by the Himalayas and in the south by the Bay of Bengal, constitutes a unique narrow passageway that connects the Indian subcontinent to East Asia and Southeast Asia. It is thought to have been a crucial corridor for human migrations between these two subcontinental areas, including, perhaps, the first migrations from Africa towards East Asia and Australia more than 40,000 years ago [7, 8, 14, 15].

Northeast India is also an area of extensive linguistic diversity where three language families are represented: Austro-Asiatic, Indo-European and Tibeto-Burman [16, 17]. Austro-Asiatic languages are now spoken by a single group in northeast India (the Khasi, composed of many subgroups), but these languages are also found in east India and Southeast Asia [17], which suggests that they might have been more widespread in northeast India in the past [18]. Indo-European languages are nowadays spoken from Europe to central and south Asia; the easternmost occurrences are in Nepal, Bangladesh, and northeast India. The arrival of Indo-European speakers into India within the past 3,500 years had a substantial impact on Indian genetic diversity [11, 19, 20, 21, 22]. Tibeto-Burman languages are a branch of the Sino-Tibetan family, which is mainly spoken in northeast India, China, and Southeast Asia [17]. Thus, northeast India constitutes an important linguistic contact zone.

2. PREDICTION VS SCIENTIFIC EVIDENCE

A putative long history of migrations, coupled with diverse cultural influences as evidenced by the high linguistic diversity, would predict that northeast India has experienced extensive population interactions that have resulted in high genetic diversity within groups and heterogeneity among groups. To test this hypothesis, researchers from Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany; biologists from Louisiana State University, Baton Rouge and WE Informatik, Heinrich-Heine-Universitaet, Germany; and scientists from Department of Pediatrics, National University of Singapore, Singapore had analyzed Y-chromosome (*type of sex determining chromosome in male gametes) and mitochondrial DNA (mt-DNA) (non sex determining somatic nuclear material) variation in the Adi, Apatani, Nishi, and Naga tribal populations, sampled from diverse northeast Indian localities [22]. They speak Tibeto-Burman languages and are also conversant in Indo-European languages, such as Hindi or Assamese [23]. Genetic variation in these groups was compared with that of other Indian and East/Southeast Asian groups. Available data from three other northeast Indian Tibeto-Burman groups, consisting of Y-chromosome data from 20 Kachari and 17 Rabha [24] and mt-DNA data from 20 Tipperah [25], were also included in some analyses.

They find that, contrary to the prediction, northeast Indian groups show a striking genetic homogeneity both in terms of Y-chromosome and mt-DNA variation, which was probably maintained over time by genetic isolation. In addition, northeast

Indians show virtually no genetic admixture with other Indian groups, which has led to a remarkable genetic discontinuity between these groups. This suggests that the northeast Indian passageway was a geographic barrier to contacts between the Indian subcontinent and East/Southeast Asia, rather than a corridor, at least within the past millennia.

3. RESULTS

Populations from northeast India were compared with 131 tribal and 24 caste south Indians [22], 72 west Indians, 66 north Indians, 31 east Indians [36], 46 Tibetans, 365 Han Chinese, 76 south Chinese [24], and 71 Southeast Asians [26].

The Indian and East/Southeast Asian contributions to the northeast Indian Y-chromosome gene pool were estimated by use of a phylogeographic approach [27] and the program ADMIX version 2.0 [28]. The two parental populations were represented by the 324 Indian and 558 East/Southeast Asian individuals described above, and standard errors (SE) were calculated on the basis of 1,000 bootstraps.

The demography of the population is defined by three parameters: initial population size, growth rate, and time since expansion. Details on the prior distribution characteristics used to model the three aforementioned demographic parameters are given [13, 29]. In brief, they cover a range of demographic scenarios that range from no growth (constant population size) to reasonable growth rates for human populations [13, 29].

The ADMIX software was used to evaluate the Indian and East/Southeast Asian contributions to the northeast Indian mt-DNA gene pool. The Indian parental population was represented by 560 tribal and nontribal individuals [30]. The East/Southeast Asian parental population was represented by 742 individuals. Standard errors were estimated on the basis of 1,000 bootstraps.

A coalescence analysis was also performed to gain further insights into the demographic history of northeast Indian groups. Growth rates of approximately 0.005, 0.015, and 0.025 per generation indicate slight, moderate, and strong signals of population growth, respectively [13, 29]. Thus, the growth rate of 0.027/generation detected in northeast India suggests a strong demographic expansion. The analysis also suggests that this expansion most likely started approximately 1,400 years ago from an initial male population size of about 120 individuals. This indicates that the founder effect or bottleneck experienced by northeast Indian males was followed by a strong demographic expansion that started from a reduced number of individuals.

4. DISCUSSION

Y-Chromosome Variation in Northeast India Tibeto-Burman northeast Indian Y-lineages appear to be more closely related to East/Southeast Asian than to other Indian Y-lineages. This is suggested that almost all northeast Indian Y-chromosomes are of East/Southeast Asian origin which has the extensive sharing of Y-chromosome lineage between northeast Indians and East/Southeast Asians, particularly Han Chinese. The demographic scenario involves a founder effect; that is, present-day northeast Indian males are derived from a small number of migrants from an East Asian source population. Alternatively, they may have gone through bottlenecks after they reached India. Further the fact that all northeast Indian populations analyzed consistently show these trends points to a founder effect during the colonization of northeast India rather than to bottlenecks. This is because bottlenecks subsequent to the colonization of northeast India would not be expected to affect all populations in the same way, unless a bottleneck happened right after the founding population arrived in northeast India, before the separation of the different groups. However, a bottleneck immediately after arriving in northeast India would essentially be the same as a founder event, for all practical purposes, because it means the reduction in diversity happened either when proto–Tibeto-Burman speakers left east Asia or right when they got to northeast India, not that they were in northeast India for a long time before going through bottlenecks.

This conclusion has important implications because, in the case of separate bottlenecks occurring in the northeast Indian populations, the start of the demographic expansion would provide an indication on the timing of the bottlenecks, not on the timing of the migration to northeast India. However, in the case of a founder effect associated with the colonization of northeast India, the demographic expansion took place immediately or shortly after the colonization, and, hence, the start of the demographic expansion probably represents a good approximation of the time of the migration to northeast India.

The coalescence analysis suggests that the expansion of Tibeto-Burman speakers to northeast India most likely took place within the past 4,200 years, which corresponds to the upper limit of the 95% probability interval of the time since expansion.

A fairly recent separation of northeast Indians from their East Asian source is further supported by the low differentiation of the different northeast Indian groups based on Y-haplogroup frequencies and the extensive sharing of Y-STR haplotypes with East Asians.

Other Y-chromosome evidence, based on 607 individuals speaking Sino-Tibetan languages (to which the Tibeto-Burman family belongs), suggested that the cradle of Sino-Tibetan speakers was in China, perhaps in the Yellow River basin [24]. Based on the allele size variance of three Y-STRs, the author inferred that proto–Tibeto-Burman speakers left China 5,000 to 6,000 years ago, which is consistent with archaeological and linguistic evidence [22, 24, 39, 42]. Indeed, almost all northeast Indian Tibeto-Burman Y chromosomes can be assigned an East/Southeast Asian origin, and the admixture with other Indian groups is negligible. This suggests that Tibeto-Burman speakers may have been the first settlers of this area, which is plausible, given the inhospitable topological, climatic, and environmental conditions of the region.

Alternatively, Tibeto-Burman newcomers may have found the land already inhabited, in which case they largely replaced the previous inhabitants of northeast India. Possible pre–Tibeto-Burman inhabitants of northeast India are Austro-Asiatic speakers, who nowadays live both west and east of northeast India [17] but are represented in northeast India by a single group (the Khasi in Meghalaya [23]. The archaeological record of northeast India provides little evidence for pre-Neolithic settlements of the area [40], which could be interpreted as favoring the former hypothesis. However, the northeast Indian archaeological record is very poor, which might explain the paucity of pre-Neolithic evidence.

In addition, the Indo-European component of Tibeto-Burman Y-chromosomes is remarkably low (3%), given that although the study groups are primarily Tibeto-Burman speakers, they are also conversant with Indo-European languages. This implies that the "Indo-Europeanization" of northeast India, which is an ongoing process [16], is mainly a cultural process. This situation contrasts with southern India, where Indo-European speakers were integrated in non–Indo-European speech communities [16] and where Y-chromosome markers typical of Indo-European speakers have been detected in Dravidian speaking tribal groups [19, 22; 41].

4.1 Y-chromosome Versus mt-DNA Variation

By contrast to the Y-chromosome, which shows greatly reduced diversity within populations, mt-DNA of northeast Indian groups is among the most diverse on the Indian subcontinent [30]. However, similar to the Y-chromosome, mt-DNA of northeast Indian groups shows limited differentiation among populations.

With regard to mt-DNA relationships, Cordaux *et al*., 2003 have shown that northeast Indian groups show closer affinities to East/Southeast Asians and are well differentiated from other non-northeast Indian groups [30]. An ADMIX analysis formally evaluating the East/Southeast Asian and Indian contributions to the northeast Indian mt-DNA gene pool confirms this trend, in that East/Southeast Asians have largely (*ca*. 90%) contributed present-day northeast Indian mt-DNAs. The mt-DNA results, thus, strikingly parallel the Y-chromosome data.

4.2 Importance of these two parameters

Y-chromosome variation is paternally-inherited and, thus, only reflects male genetic history. How does it compare with mt-DNA variation, the female equivalent of the Y chromosome? Y-chromosome and mt-DNA variation differ in northeast Indian groups in that reduced Y-chromosome diversity contrasts with high mt-DNA diversity, as opposed to other Indian tribal groups [22, 30]. This may be attributable at least in part to the patrilocal residence rule of these groups (in which women move to their husband's residence after marriage), because this leads to diverse Y-chromosomes entering a population at a lower rate than mt-DNA [31, 32]. However, under this scenario, one expects to find a correlation between Y-chromosomes and geographic distances and no correlation between mt-DNA and geographic distances [31]. Nevertheless, northeast Indian groups do not adhere to this trend (mt-DNA: r2 ¼ 0.77, P¼ 0.55; Y-chromosome: r2¼ 0.03, P ¼0.44), perhaps because of their low Y-chromosome and mt-DNA differentiation or because of the relatively low number of populations compared. Another factor that may have contributed to elevation of mt-DNA but not Y-chromosome diversity is gene flow with Indian groups, because mt-DNA does indicate about 10% genetic contribution from India. Alternatively, the different patterns of Y-chromosome and mt-DNA diversity observed in northeast India may be best explained by a male-specific founder effect during the colonization of northeast India. This scenario actually finds support in the fact that mt-DNA evidence suggests an expansion time approximately 50,000 years ago. This estimate is very similar to that deduced for most human populations [33].

Thus, it is more parsimonious to infer that the mt-DNA expansion time relates to the human expansion out of Africa, rather than to multiple independent and simultaneous expansions during the colonization of each geographic area. The discrepancy between mt-DNA and Y-STR expansion times can be explained by the different mutation rates for each system, which allows them to capture different demographic events during human evolution. It is noteworthy that a recent loss of diversity (through bottleneck or founder effect) can erase signals of past population expansion [33]. As the northeast Indian mt-DNA gene pool carries a signal of expansion approximately 50,000 years ago (as do the mt-DNA gene pool of most other populations), it is reasonable to conclude that northeast Indian females did not experience any substantial recent loss of genetic diversity, contrary to northeast Indian males.

Similar to the Y-chromosome evidence, mt-DNA evidence clearly indicates close genetic affinities between northeast Indian and East Asian groups [30] with hardly any contribution from non northeast Indians to the highly homogeneous northeast Indian mt-DNA gene pool. In sum, both Y-chromosome and mt-DNA evidence indicate that northeast Indian groups have remained genetically isolated for centuries, without admixing with their close Indian neighbors. The high incidence of genetic traits such as color blindness (e.g., which occurs at more than 10% in Apatani [23, 34] suggests considerable levels of inbreeding in these groups and provides additional evidence for their genetic isolation.

5. CONCLUSION

The findings are surprisingly contradictory with the initial prediction of high genetic heterogeneity and diversity in northeast India, based on the fact that the northeast Indian passageway is an important linguistic contact zone, and it is generally believed to have been a key area for migrations between India and East/Southeast Asia [21].

Genetic analyses of other postulated corridors have shown evidence of clinal variation and/or admixture between populations located adjacent to corridors such as the Nile River Valley [9], central Asia [10, 11, 12, 35], and eastern Indonesia [13]. However, there is a strikingly high genetic homogeneity in northeast India, coupled with a remarkable discontinuity in both Y-chromosome and mt-DNA variation between northeast India and the rest of India. In the light of the present genetic evidence, it is suggest that the northeast Indian passageway acted as a geographic barrier between the Indian subcontinent and East/Southeast Asia, rather than as an important corridor connecting these two major subcontinental areas, at least since the arrival of Tibeto-Burman speakers in northeast India.

Several recent studies have emphasized that the mt-DNA and Y-chromosome gene pools of the Indian subcontinent and East/Southeast Asia are related but overall fairly distinct [19, 22, 25, 30, 36, 37, 38]. The relatedness of the two gene pools may be interpreted as an indication that the northeast Indian passageway acted as a corridor between the Indian subcontinent and East/Southeast Asia during the initial settlement of the latter area. However, the distinctiveness of the same gene pools argues against considerable gene flow between the two areas for a long period of time, perhaps as long as 30,000 years, as suggested by mt-DNA evidence [38]. Taken together with the evidence presented in this study, it can be concluded that the northeast Indian passageway mainly acted as a barrier to migrations during most of modern human history.

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CONFLICT OF INTEREST

The author declare that there is no conflict of interest.

ETHICS STATEMENT

Ethical approval was not required for this study.

REFERENCES

[1] Wilson Flona and Bodil Folke Frederiksen, 2000; *Ethnicity, Gender and the Subversion of Nationalism*, London: Frankcass & Co Ltd. in association with The European Association of Development, Research and Training Institute, Geneva.

[2] Trimble Joseph E. and Ryan Dickson, 2010. In C. B. Fisher & Lerner, R. M. (edt) *Applied developmental science:An encyclopedia of research, policies, and programs*; Thousand Oaks:Sage.

[3] Subba, T.B, 1996, 'Ethnicity, Culture and Nationalism in North –East India: A Conspectus', in M.M. Agarwala edt. *Ethnicity, Culture and Nationalism in North East India,* New Delhi: Indus Publication Pp.39-58

[4] Baruah, A. K, 2004, 'Identity Crisis in North East India and its consequences', in Thomas Vattathara and Elizabeth George (edt.) *Peace Initiatives-A North East India Perspective*, Guwahati: Don Bosco Publications, Pp17-27

[5] Garg Pranami, 2007. Aspiration for an Ethnic Identity- Evolved or Created a question asked in the context of Assam. Paper presented in National Seminar on "Ethnic Identity, Social Formation and Nation Building with special reference to North East India" held at Department of Anthropology, Dibrugarh University, Dibrugarh in March 26-27, 2007.

[6] Datta, Brijendranath. 1990. "Ethnicity, Nationalism and Sub-Nationalism, with Special Reference to North-East India". In D. Pakem (ed). *Nationality, Ethnicity and Cultural Identity in North-East India.* New Delhi, Omsons Publications, pp. 36-44.

[7] Cavalli-Sforza, L. L., P. Menozzi, and A. Piazza. 1994. History and geography of human genes. Princeton University Press, Princeton, NJ Lahr, M. M., and R. Foley. 1994. Multiple dispersals and modern human origins. Evol. Anthropol. 3:48–60.

[8] Lahr, M. M., and R. Foley. 1994. Multiple dispersals and modern human origins. Evol. Anthropol. 3:48–60.

[9] Krings, M., A. H. Salem, K. Bauer et al. (13 co-authors). 1999. MtDNA analysis of Nile River Valley populations: a genetic corridor or barrier for migration? Am. J. Hum. Genet. 64:1166–1176.

[10] Karafet, T., L. Xu, R. Du, W. Wang, S. Feng, R. S. Wells, A. J. Redd, S. L. Zegura, and M. F. Hammer. 2001. Paternal population history of East Asia: sources, patterns, and microevolutionary processes. Am. J. Hum. Genet. 69:615–628.

[11] Wells, R. S., N. Yuldasheva, R. Ruzibakiev et al. (27 co-authors). 2001. The Eurasian heartland: a continental perspective on Ychromosome diversity. Proc. Natl. Acad. Sci. USA 98:10244–10249.

[12] Zerjal, T., R. S. Wells, N. Yuldasheva, R. Ruzibakiev, and C. Tyler-Smith. 2002. A genetic landscape reshaped by recent events: Y-chromosomal insights into central Asia. Am. J. Hum. Genet. 71:466–482.

[13] Kayser, M., S. Brauer, G. Weiss, P. A. Underhill, L. Roewer, W. Schiefenho¨ vel, and M. Stoneking. 2000. Melanesian origin of Polynesian Y chromosomes. Curr. Biol. 10:1237–1246.

[14] Nei, M., and A. K. Roychoudhury. 1993. Evolutionary relationships of human populations on a global scale. Mol. Biol. Evol. 10:927–943.

[15] Cann, R. L. 2001. Genetic clues to dispersal in human populations: retracing the past from the present. Science 291: 1742–1748.

[16] Masica, C. P. 1991. The Indo-European languages. Cambridge University Press, Cambridge, UK.

[17] Ruhlen, M. 1991. A guide to the world's languages, Vol 1. Stanford University Press, Stanford, Calif.

[18] Abbi, A. 1991. Reduplication in south Asian languages: an areal, typological and historical study. Allied Publishers, New Delhi.

[19] Bamshad, M., T. Kivisild, W. S. Watkins et al. (18 co-authors). 2001. Genetic evidence on the origins of Indian caste populations. Genome Res. 11:994–1004.

[20] Quintana-Murci, L., C. Krausz, T. Zerjal T et al. (13 co-authors). 2001. Y-chromosome lineages trace diffusion of people and languages in southwestern Asia. Am. J. Hum. Genet. 68: 537–542.

[21] Basu, A., N. Mukherjee, S. Roy et al. (12 co-authors). 2003. Ethnic India: a genomic view, with special reference to peopling and structure. Genome Res. 13:2277–2290.

[22] Cordaux, R., R. Aunger, G. Bentley, I. Nasidze, S. M. Sirajuddin, and M. Stoneking. 2004a. Independent origins of Indian caste and tribal paternal lineages. Curr. Biol. 14:231–235.

[23] Singh, K. S. 1998. People of India: India's communities, Vol IVVI. Oxford University Press, Delhi, India.

[24] Su, B., C. Xiao, R. Deka et al. (11 co-authors), 2000b. Y chromosome haplotypes reveal prehistorical migrations to the Himalayas. Hum. Genet. 107:582–590.

[25] Roychoudhury, S., S. Roy, A. Basu, R. Banerjee, H. Vishwanathan, M. V. Usha Rani, S. K. Sil, M. Mitra, and P. P. Majumder. 2001. Genomic structures and population histories of linguistically distinct tribal groups of India. Hum. Genet. 109:339–350.

[26] Su, B., L. Jin, P. Underhill et al. (11 co-authors), 2000a. Polynesian origins: insights from the Y chromosome. Proc. Natl. Acad. Sci. USA 97:8225–8228.

[27] Cordaux, R.; Weiss, G.; Saha, N.; Stoneking, M., 2004b. The Northeast Indian Passageway: A Barrier or Corridor for Human Migrations? Mol. Biol. Evol. 21(8):1525–1533.

[28] Dupanloup, I., and G. Bertorelle. 2001. Inferring admixture proportions from molecular data: extension to any number of parental populations. Mol. Biol. Evol. 18:672–675.
[29] Kayser, M., S. Brauer, G. Weiss, W. Schiefenho¨ vel, P. A. Underhill, and M. Stoneking. 2001. Independent histories of human Y chromosomes from Melanesia and Australia. Am. J. Hum. Genet. 68:173–190.
[30] Cordaux, R., N. Saha, G. R. Bentley, R. Aunger, S. M. Sirajuddin, and M. Stoneking. 2003. Mitochondrial DNA analysis reveals diverse histories of tribal populations from India. Eur. J. Hum. Genet. 11:253–264.
[31] Seielstad, M. T., E. Minch, and L. L. Cavalli-Sforza. 1998. Genetic evidence for a higher female migration rate in humans. Nat. Genet. 20:278–280.
[32] Oota, H., W. Settheetham-Ishida, D. Tiwawech, T. Ishida, and M. Stoneking. 2001. Human mtDNA and Y-chromosome variation is correlated with matrilocal vs. patrilocal residence. Nat. Genet. 29:20–21.
[33] Excoffier, L., and S. Schneider. 1999. Why hunter-gatherer populations do not show signs of Pleistocene demographic expansions? Proc. Natl. Acad. Sci. USA 96:10597–10602.
[34] Jaswal, I. J. S. 1975. Anomalous color vision among three tribes of Arunachal Pradesh, India. Anthropologist 22:60–64.
[35] Comas, D., S. Plaza, R. S. Wells, N. Yuldaseva, O. Lao, F. Calafell, and J. Bertranpetit. 2004. Admixture, migrations, and dispersals in Central Asia: evidence from maternal DNA lineages. Eur. J. Hum. Genet. 12:495–504.
[36] Kivisild, T., M. J. Bamshad, K. Kaldma et al. (14 co-authors). 1999. Deep common ancestry of Indian and western-Eurasian mitochondrial DNA lineages. Curr. Biol. 9:1331–1334.
[37] Kivisild, T., S. Rootsi, M. Metspalu et al. (18 co-authors). 2003. The genetic heritage of the earliest settlers persists both in Indian tribal and caste populations. Am. J. Hum. Genet. 72:313–332.
[38] Forster, P., A. Torroni, C. Renfrew, and A. Ro¨ hl. 2001. Phylogenetic star contraction applied to Asian and Papuan mtDNA evolution. Mol. Biol. Evol. 18:1864–1881.
[39] Etler, D. A. 1996. The fossil evidence for human evolution in Asia. Annu. Rev. Anthropol. 25:275–301.
[40] Misra, V. N. 2001. Prehistoric human colonization of India. J. Biosci. 26:491–531.
[41] Ramana, G. V., B. Su, L. Jin, L. Singh, N. Wang, P. Underhill, and R. Chakraborty. 2001. Y-chromosome SNP haplotypes suggest evidence of gene flow among caste, tribe, and the migrant Siddi populations of Andhra Pradesh, South India. Eur. J. Hum. Genet. 9:695–700.
[42] Wu, X. Z., and F. E. Poirier. 1995. Human evolution in China. Oxford University Press, Oxford, UK.