Population Geography 44 (2): (December 2022) *ISSN No.0256-5331*

Geo- Reflections

Cartographic Traditions, Innovations and Revolutions: The Arrival of Digital Cartography in India

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Cartography as a medium of expression and illustration is known to have existed in antiquity. The historians of cartography go as far as to view a line etched on a piece of a tusk, dated to 25,000 BC, as a simplified form of cartography. While this may not quite fit with our idea of cartography, many other representations of the outline of the world, or a part of it, cannot be denied their claim as valid pieces of cartographic representations. "The earliest extant example of a portable map dates to the Babylonian empire and is dated circa 3800 BC. The Babylonians were pioneers in studying the world and its place in the cosmos, crucial in the development of Cartography" (Swift, 2006, p.11). One, however, wonders if a clay tablet with an etched impression of a river and a delta that the Babylonian map represented could be considered a map.

Most of the old maps, one may call them ancient, generally originated in the Mediterranean region. One of the earliest thinkers was Anaximander of Miletus (611-546 BC), who drew the first map of the known world. Other early maps of the world, howsoever incomplete and crude they may appear, by Hecataeus (550 BC), Eratosthenes (200 BC) and Ptolemy (150 AD), hundreds of years apart, decidedly represent the very early stage of cartographic evolution in the world. Based partly on their knowledge of the physical world and partly on logical imagination, early Greek geographers prepared small-scale maps of the world, often confined in a circle. They had a compelling attraction to show the world (known to them) in a limited circular frame, corresponding with the shape of the world.

The map prepared by Claudius Ptolemy was on a sounder footing, as by the mid-second century AD, more of the world, especially Asia, was known from the conquests of Alexander and many travellers. However, equally pertinent is that by the time Ptolemy appeared on the scene at the close of the second century AD, one of the greatest geographical principles of locational coordinates (latitude and longitude) was well established. It would be appropriate to point out that the coordinates of a place, expressed by latitudes and longitudes, now taken as a given fact, is a major geographical contribution made by Hipparchus (190–120 BC), a Greek geographer and astronomer. The coordinates were used for the first time by Ptolemy in his well-known semi-spherical map of the world, extending from the shores of the Atlantic in the west to the China Sea in the east, with the Ganges delta thrown in the eastern segment.

The appearance of an Arab world in the Mediterranean region, covering a large part of North Africa, part of Spain and other regions around the Mediterranean, coincided with a simultaneous emergence of many Arab scholars interested in the world's geography. One such scholar who is widely recognised as a cartographer was Muhammad-Al-Idrisi (1100–1169), who produced some of the most accurate maps of the medieval Islamic period, known as "Tabula Rogeriana" (1154 AD), a kind of medieval atlas with 70 sheets. The atlas consisted of a series of rectangular maps based on the knowledge gathered from travellers. Besides the Mediterranean world, it contained maps of parts of Africa and the Indian Ocean. An uncommon feature of the maps was the direction, the north pointing downward, and to orient it according to modern convention, the maps with Arabic scripts had to be turned upside down for proper orientation.

Exploration Phase and Cartography

Much of the world was discovered in less than a hundred years, from the beginning voyage of Columbus in 1492 to the end of the exploratory voyage of Magellan in 1522. Almost at the same

time, when Columbus was exploring West Indies and brought forth a wealth of information about the new world, Vasco da Gama, in an attempt to discover the spice land, sailed east, landing at Calicut (now Kozhikode) on the Indian coast in 1498. To find a western route to the East Indies, Magellan circumnavigated the world, traversing the Atlantic Ocean, sailing along the east coast of Latin America and crossing over to the Pacific, through the Magellan Strait, reached the Philippines, where local tribes killed him. James Cook, however, discovered Australia later in the 18th century.

Knowledge and Cartography of the Globe

What is important to realise is that by the close of the 15th century and the beginning of the 16th century, the outline of much of the globe, with its oceans and continents, was known enough to induce the cartographers of the world to attempt a map of the earth on the globe. Renaissance, as we call this period, was when all round growth of knowledge was accelerated, especially in science: and this also impacted cartography. The invention of theodolite in the 16th century, much improved by Jonathan Sisson (1725) in what was, till lately, a modern theodolite, gave the necessary impetus for producing maps based on accurate measurements. It is said that "most of the cartographers of the fifteen-century lived either in Venice or Genoa because it was from these two places that Europeans departed on voyages to the Eastern Mediterranean, to pick up cargoes of valuable items from the east".

Cartography in Europe

Cartography in Europe, to start with, developed in the Low Countries, like the Netherlands, though the Portuguese and Spaniards were the great explorers. The reason often advanced is the rise of the protestant sect of Christianity that allowed thinking independently without the fear of inquisition by the Catholic Church. A long list of cartographers emerged in the 15th and early 16th centuries, but these cannot be mentioned for want of space. One of the widely acknowledged, however, was Gerardus Mercator (1512-1594). Mercator is known for the world map he produced in 1569. This was an eighteen-sheet world map drawn on what is known today eponymously as Mercator projection. In this map projection, the azimuths were represented by straight lines, enabling the navigators to plot their courses by straight lines. This projection became immensely popular with sailors and enjoyed a long lease of life. Unfortunately, as we know, the distances and the areas were highly exaggerated, giving the countries a distorted shape.

Another contemporary of Mercator was Abraham Ortelius. Though the name 'Atlas' for a collection of maps was given by Mercator, the actual atlas, titled "Theatrum Orbis Terrarum", was produced and published by Abraham Ortelius in 1570.

A Stable Phase in Cartography

Sixteenth century onward, a stable phase in the development of cartography occurred. More and more accurate information based on the precise survey was added, and the quality and accuracy of maps improved speedily. The old maps, like those of Ptolemy, were corrected in the light of new knowledge.

From small-scale maps of the world to large-scale maps of small areas

Following Mercator, there was a rush in the production of maps of sections of the earth, countries, provinces, coastal areas and cities. By the close of the 18teenth century, most continents had a relatively accurate map. The earliest map of Asia, entitled "Asia Empires, Kingdom and States", was compiled by Sieur D'Anville (1772).

The Early Indian Cartography

There are many references to cartographic works in India. Nevertheless, the British, in general, are credited with surveying and preparing accurate maps of India, or parts of it, on different scales. This

is not to say that cartography was not known in India. The Moghul emperors, especially emperor Akbar, had a penchant for surveying, but it is doubtful they had maps prepared on different scales. According to Irfan Habib (Proceedings of the Indian History Congress, vol. 35, 1974, pp.150-62), maps of the Moghul period could be included in the history of cartography. At the same time, Lahiri (2012) mentioned that in the Moghul period, a Persian world atlas showed the inhabited quarters (world) in brilliantly coloured maps.

More relevant, as an important piece of cartography, is the atlas "Maps of Moghul India" drawn by Col. Jean Baptiste Joseph Gentil, agent for the French Government in the court of Shuja-ud-daula of Faizabad, during the 1770s. "Essai Carte Generale de l'Indoustan ou Empire Mogol" was published in 1782 and reprinted in 1988 (Manohar). It is difficult to say if Gentil's maps anticipated the maps of James Rennel. One may, however, observe that Gentil's maps were more akin to sketches carrying place names and rivers. These are, nevertheless, valued as they show the partial reality of Moghul India in the 1770s.

The Arrival of East India Co., Trigonometric Surveys and the Production of Maps and Atlases

The central figure in the introduction of modern cartographic techniques and the production of maps in India is James Rennel (1742-1830), "a cartographer with interest in oceanography, turned a cartographer, who laid the foundation of accurate mapping in India". Employed by the East India Co. as the Surveyor General of Bengal, he surveyed the Ganges, prepared the Bengal Atlas in 1779, and finally prepared the earliest map of India under the title ***Memoir of a Map of Hindoostan, or, The Mogul Empire'*** in 1782.

Survey of India and the Golden Age of Cartography

It may be emphasised that the 'Land Survey' in the USA started in 1785, just when Rennel completed his map of Hindoostan. The point to emphasise is that in India, though a colonial possession of the British, the survey and mapping work started much ahead of many other countries. The knowledge of the land was important to the British colonialists, not only for revenue collection but to explore and exploit the country's rich resources like forests and minerals.

The Survey of India was set up in 1767 to survey and map the country. The actual survey work, however, started at the beginning of the 19th century. Colin Mackenzie, the first Surveyor General of India, continued surveying the Mysore region to consolidate the East India Co's hold on the kingdom of Tipu Sultan after the latter's fall in 1799. However, a detailed trigonometric survey was undertaken only in 1802, under the leadership of William Lambton and completed in 1871, during the regime of James Walker, the then Surveyor General of India. During this long period, George Everest of Mt. Everest fame and Andrew Scott Waugh worked as Surveyors General. Theodolite (a crude one measuring one metre and weighing 50 kg) was used for the first time during this survey. The process of triangulation helped fix The Great Indian Arc of the Meridian through a web of triangulations that ran roughly along 78° E longitude, covering a distance of about 2400 km. Much of the country was surveyed by the end of the 3rd quarter of the 19th century and was concurrently mapped, putting together the survey results.

The Survey of India produced maps on different scales like million sheets, quarter-inch sheets (also called degree sheets), half-inch and one-inch sheets, the last being on a scale of one inch to a mile, the largest scale topographic map available till the mid-fifties of last century. However, the introduction of the metric system led SOI to transform these maps to 1:1,000,000, 1:250,000 and 1:50,000 (the equivalent of an old one-inch sheet) and even an enlarged version on a scale of 1:25,000.

Fixing the Zero Meridian and the International Map Series

Till the end of the nineteenth century, there was enough confusion about a zero-degree meridian. It was only in 1884 that an international conference in Washington, DC agreed on the Greenwich

meridian, which was adopted as the 0° meridian. Secondly, during the Fifth Geographical Congress in 1891 in Berne, the proposal to prepare international maps, to cover the entire world on a scale of 1:1,000,000, using uniform symbols was accepted. Thus, a set of standard maps, the so-called million sheets for the whole world, were produced. These two aspects, fixing the 0° meridian and the coverage of the world by standard million sheets, greatly facilitated the internationalisation of cartographic work.

The Survey of India has done pioneering work in all areas of surveying and mapping, notwithstanding the restrictive policy of the Government of India. They are the custodians of all related maps of the country, revising, updating and incorporating the latest information.

The Arrival of the Digital Age: A Cartographic Revolution

The arrival of digital cartography took place in the last quarter of the 20th century. The maps are now stored in digital form that can be reconstructed into a map at any time with the flick of a computer cursor. Nevertheless, conversely, the map's contents could be digitised and stored in digital form to be recalled to make a hard copy. The data, a matrix of cells in rows and columns, is stored in either vector form that digitises the points, lines and polygons or in raster form obtained from the satellite imageries in pixel form that depict a segment of the earth. Thus, both kinds of data, stored and subjected to a computer-aided Geographical Information System, provide a map of the area. The Indian Institute of Remote Sensing (IIRS), an affiliate of ISRO (Indian Space Research Organisation), has been able to train several earth scientists in the science of Remote Sensing, GIS, and the construction of maps. The result is that most universities in India have started a certificate or diploma, or even a degree course in GIS and Remote Sensing.

Applying GIS (Geographical Information System) and Remote Sensing has generated a belief and even an understanding that conventional cartography, embodying scientific principles and aesthetic elegance, is no longer needed to make maps and atlases. The satellite images representing remote sensing results have enough information to enable a trained cartographer to produce maps and atlases using conventional signs and symbols. In other words, it is possible to transform the imagery into a conventional topographic map directly. Of course, many of the non-visible attributes have to be incorporated when a thematic map is prepared. Nevertheless, the thematic maps are quite amenable to digital cartography.

The Big Debate

The Satellite imageries constructed from raster data could be transformed into a map, like a topographic sheet, with all the visible features. The question: has the country, with many university departments specialising in GIS and Remote Sensing, been able to produce maps and atlases based on these imageries or using the stored vector and raster data? Have we produced regional atlases by manipulating the GIS data? Alternatively, 'GIS and Remote Sensing' will remain confined to classrooms as a theoretical exercise. One does not deny that there are multiple uses and advantages of GIS and Remote Sensing, and its importance as a field of applied science cannot be over-emphasised. Some commercial concerns like Google have utilised the remote sensing technique to a very advanced level, to the extent that there is hardly an individual who remains untouched and does not use Google in one form or the other. Yet, we are talking about cartography.

Even today, some of the most informative and aesthetically appealing atlases continue to be produced. Another aspect is the mapping of non-geographical information, like historical facts, social organisation, or cultural practices, where an expanded skill and a degree of imagination are required to give these different aspects a visual form. It would go much beyond remote sensing. The situation will be salvaged only by a trained cartographer applying even graphic art where necessary.

Imageries are Not Maps

Though satellite images are not maps, they are instrumental in observing the ground details. These can, no doubt, be manipulated by applying specific software to classify, calculate and roughly map the surface without any attributes or names inscribed. So the real question is – Are the historical atlases (like the "Historical Atlas of South Asia" by Joseph Schwartzberg) or cultural or demographic atlases amenable to GIS and Remote Sensing exercises?

One may ask: With a band of trained personnel and increased capacity building in the universities, can we produce maps and atlases? The benefits of imageries are obvious in engineering works, forest management, agricultural land use and many other fields, but could these replace the conventional atlases and maps?

Why doesn't India produce maps of other parts of the world?

Maps worldwide are produced on different scales commercially and marketed globally. One can buy a map of India, or any other part of the world, on a scale of 1:1,300,000 with as much information as our million sheets contain, or even more, from overseas sources. A map of India and Pakistan could be brought with a 250 m contour interval on a scale of 1:1.3 million. Similarly, all kinds of atlases are produced all over the world. Neither the Survey of India nor any other commercial enterprise in India produces maps of other countries or other parts of the world and remains tethered to producing topographic, thematic maps and atlases of India. Survey of India, the National Atlas and Thematic Mapping Organization (NATMO), both Government Organisations, have stuck to traditional mapping or prepare maps in a "mission mode" as the Government of India requires.

As I see, GIS and Remote Sensing has become highly technical subject. Earth Scientists and most Government departments, like Agriculture, Mining, Forests, Fisheries and many others, use its products, mainly satellite imageries. But where is cartography?

Teaching and Research in Cartography

There are still institutes in Switzerland and Germany, among other countries, which offer Masters Programme in Cartography. It is something different from GIS and Remote Sensing. The latter is a part of the entire course structure. Let there be no impression that the art and the science of cartography is redundant.

Need for an Institute of Cartography: India badly needs an institute of cartography as an autonomous institute or an affiliate of the Survey of India. Such an institute will not only teach the latest development in cartography but will explore the frontiers of the science of map-making. If established, it would be a depository of all possible maps of all parts of the world and atlases and other cartographic literature and a permanent source of all information relating to maps of any part of the world. It may take time, but a cartographic library could be built over the years.

II

The Indian Cartographic Tradition

In the present context, it appears appropriate to look at the tradition of Indian cartography as a segment of cartographic evolution. There is some advantage in looking at the Indian tradition in two parts: 1. Early and Pre-European tradition, if any, of cartography in India, and 2. European inspired, promoted and executed works of Indian cartography. In the first case, one looks at the cartographic works executed before 16 the century: and in the second category, it is largely the plans, maps and atlases of the Indian territory or a part of it prepared after the seventeenth century. It is based mainly on the work of the Survey of India, starting with the works of James Rennel, the Surveyor General of Bengal, and subsequently of the Survey of India (SOI) and the latter's unparalleled achievements in the 19th century. More light is thrown on SOI in the sequel.

Pre-European Tradition of Indian Cartography:

The first question to answer in this context is: did anything like an Indian cartographic tradition exist? In a survey of writings on Indian historical geography, as a part of the Survey of Research in Geography by the Indian Council of Social Science Research (ICSSR) Raza and Ahmad (1972) observe that "there exists no evidence of an indigenous tradition of map making". While this may be a generalised view of geographers, there have been scholars of Indology and Indian history who sought to demonstrate the existence of surveying and the knowledge of cartography in ancient India. Tripathi (1963), in his paper "Survey and Cartography in Ancient India", quoted different ancient texts, especially the *Sulavasutra,* to demonstrate that the art of surveying and cartography was known to Indians. He elaborated his view further in his book "Development of Geographic Knowledge in Ancient India- (Varanasi, 1969), in which a long chapter is on *Survey, Cartography and Cartographic Symbolism*. References to Ancient Indian Cartography also appear in Sircar's "Studies in the Geography of Ancient and Medieval India (1981)". Most of these works and references heavily rely on the idea of measurement and geometrical or other specific forms, as mentioned in the ancient Indian texts. In the opinion of the present author, nothing that is known by way of references of measurements, survey work, or geometrical and astronomical figures and calculations, either from the *Vedic literature or* from other ancient texts, puts us on an unassailable ground to establish the existence of a cartographic tradition in Ancient India definitively.

The views of several Indologists who thought that there existed a tradition of survey and cartography in Ancient India is evaluated by Schwartzberg (1992) in chapter-2, “Introduction to South Asian Cartography”, which he contributed to the "History of Cartography", a much larger work containing several volumes. "Schwartzberg, like many others, believes that although there are grounds to suppose that “Indians produced maps for roughly two millennia, before the advent of the Portuguese- and possibly over a considerably longer period, virtually nothing in the way of ancient cartography survives***. "Apart from incised potsherds of the second or first century BC that bear rough plans of a monastery and a few ancient sculptures depicting sacred rivers, there is no extant cartographic or cosmographic of a distinctly Indian stamp that can be unequivocally dated to any date earlier than 1199-1200, the date of a Jain bas-relief representation in stone of the mythical continent Nandisvardvipa which to European eyes would not appear to be a map".*** Yet, more than sixty per cent of the length of the chapter, Schwartzberg talks of Indian antiquaries, starting from Vedic times, including the *Sulava Sutra, the satapatha Brahman, Mahabharata and Ramayan*, and, in the process, invents a new term called “Verbal cartography” Schwartzberg quotes Basham to show that there were measurements of land during the Mauryan period, and Stella Kramrisch to suggest that the old Hindu temples involved advanced planning and measurement according to a plan.

His elaboration of Indian Cartography contains sub-titles like`-**THE NATURE OF THE INDIAN CORPUS TEXTUAL SOURCES AND ARCHAEOLOGICAL RECORD,"** wherein he discusses the Harappan Culture, the Vedic sacrificial Altars, and ancient knowledge of Geography and Cosmography, Indian Astronomy, model Architectural Plans, from ancient and medieval India. He reproduces sixteen figures through illustrations, including cave paintings, bas-relief, sketches of sacrificial altars, and a Jaipur plan.

While going through his writing of the traditional Indian cartography, one cannot escape the feeling that he has struggled to collect and include everything he laid his hands on, relating to Vedic rituals, ancient Indian iconography, astronomy, and even cave painting and pieces of bas-relief. For example, the reproduction of Ganga-Yamuna in bas-relief at Udaigiri (Ujjain-MP) as a cartographic work would appear incongruous, if not outright absurd. Similar is the case of rock paintings of Bhim Betka—a place forty km from Bhopal—or Mahararia from Mirzapur in UP, taken from secondary sources and reproduced in the text, could by no stretch of imagination represent a map.

It appears, in his efforts to discover cartographic pieces in India and document all that he discovers by way of non-textual material like pre-historic figures, paintings, bas-relief, the remnant of sketches, or even description that suggests measurements of land, he includes in his enumeration of the corpus of Indian cartographic work.

Cartography in Medieval India

One of the oft-quoted authors and a savant of Medieval India, Ahmad-al- Biruni, though a very distinguished man of letters and familiar with India, wrote Kitab-al- Hind besides a history of India - *Tarikh al-Hind*. Elsewhere he compiled a list of places and the distances between them but produced hardly anything that could qualify as a cartographic work.

More to the point are the frequent references to Mughal cartography, especially during emperor Akbar's time, as recounted by a Jesuit, Father Monserate, who recorded the measurement of roads along the marches and quoted the journey of Akbar from Delhi to Kabul. This gave rise to what is referred to as strip maps in the memoir of James Rennel. Some maps- and probably the only ones, of medieval India are found in the edited volume - "***Maps of Mughal India",*** an atlas commissioned by Col Jean Baptist Joseph Gentil (1770). These maps were edited and reproduced by Susan Gole (1988), who observed that "For the first time, the map of India was drawn from an indigenous source and showed the political divisions of local administrative units according to local sources, and not from the grabbed account of foreign visitors". With 21 maps, the collection of maps by Gentil is unique as it is a pre-British, but contained maps only of Mughal India. It may be noted that Col. Jean-Baptiste-Joseph Gentil was an agent of the French Government to the court of Shuja-ud-daula at Faizabad for 25 years and was familiar with the Gangetic basin. His maps, therefore, included the *Doab*, the river Ganga, the cities along it and even some parts of the Bay of Bengal coast, from Calcutta to Ganjam.

The Mughal cartography, as an art, has been quoted by Irfan Habib, who emphatically mentioned the existence of a 17th century world atlas contained in a more extensive encyclopaedic work by Sadiq Isfahani of Jaunpur. There is no doubt that the Mughals had an idea of survey and measurement of land and may have produced cadastral maps, but whether they produced large-scale maps of their empire or part of it is questionable. Nevertheless, they knew the routes and distances from which they may have produced route maps.

Cartography under European Tradition

This refers to the maps of India or its regions prepared on a scale by Europeans or others under their direction. In this category, no one gets precedence over James Rennel, a founder member of the Royal Geographical Society. However, in our context, the Surveyor General of the East India Co., starting with the Survey of Ganges for navigation (1764), produced several maps of Bengal, put them together in an atlas, "A Bengal Atlas-1779", and finally produced his most famous cartographic work - "Memoir of a Map of Hindoostan; Or, The Mogul Empire" (1782). This began a long process of surveying and map-making in India. Though not very accurate, Rennel's map of Hindoostan was the first of its kind, drawn on a scale on a network of latitudes and longitudes and carrying a gazetteer at the end that could help future map makers. What is overlooked is the inscription on the title page and the cartouche, an ornamental part in most of the maps of the earlier period. The cartouche in Rennel's map carries a halftone picture of Britannica with many Brahmans with their sacred books in a posture of subjugation with the following inscription at the bottom- "***Britannia receiving into her protection, the sacred books of the Hindoos, presented by pundits or learned Brahmins: an allusion to the humane interposition of the British legislature in favour of the Natives of Bengal" in the year 1781. In the cartouche, Britannia is supported by a pedestal engraved on the victories, through which the British nation obtained and has hitherto upheld its influence in India***"- a very demeaning statement. One may justifiably ask: Was it a simple map-making exercise or just

"cartography in the service of the empire, " as Dikshit (1998) suggested? This shows what the entire apparatus of East India Co. thought of Indians.

Survey of India

Survey and map making in India under the European tradition is synonymous with the Survey of India. Established in 1767, much of the survey and cartographic work in India on modern lines was started by SOI: and SOI is still the sole Government organisation engaged in survey and cartographic work. The most challenging task accomplished by the Survey of India, way back at the beginning of the 19th century, was the survey of the country by triangulation and fixing of the prime meridian as a reference meridian, as discussed earlier. The survey work started in 1802 and ended in 1871. It may be mentioned that the survey and mapping of India was a pioneer work, and one of the earliest exercises in triangulation and mapping in the world

In passing, one may mention the contribution of India to the triangulation survey. The British Engineers and surveyors trained the Indians in the art of surveying and even trigonometric calculation, especially the surveyors from Bengal. However, the most famous story is that of Nain Singh and his brother, who found the way to, and details of several geographical features of Tibet, including the height of Tibet. Trained at Dehradun for a couple of years to travel incognito, Nain Singh's achievements are the stuff of folklore associated with the Survey of India.

Other Organisations Producing Maps and Atlases

The maps prepared by the Survey of India, like the topographic maps, small-scale maps, atlases, town maps or maps of specific areas, are legion. Maps and map-making in India are virtually synonymous with the Survey of India. India is privileged to have inherited such an organisation with an enormous archive of maps, charts, documents and historical records.

Besides the Survey of India, a couple of other Governmental organisations produce maps and atlases. These include National Atlas and Thematic Mapping Organisation (NATMO). Known earlier as the National Atlas Organisation (NATMO), it was established by the Government of India in the fifties of the last century under the directorship of Professor S. P. Chatterjee. Starting with a modest beginning, the organisation has grown admirably, producing, today, broadly, thematic maps as required by the Government of India. Starting with a general atlas of India on a scale of 1:5,000,000 and subsequently maps of different parts of India on a scale of 1:1,000,000, NATMO now produces maps of different genres- regional, thematic, or even problem-oriented maps. Besides NATMO, the Census of India has started producing excellent thematic maps of languages, tribes or other aspects of the Indian population. The Census of India has an ancient tradition of map-making. Some of the early maps of Bengal carry excellent pieces of cartographic work. Certain states' Directorates of Statistics produce Statistical Atlases containing the latest statistical information. Most Government ministries and departments have their cartographic sections to produce required maps. Lately, some private organisations like "Map My India" have started producing maps under a licence from Survey of India.

The Contribution of Indian Geographers to Cartography

The contribution of Indian Geography to cartography in general, and the cartography of the country, in particular, is manifold. Firstly, they have kept the science of map-making alive. Most universities have courses on surveying, map projection and statistical mapping. Some have contributed by physically producing a set of maps. To start with, "Bengal in Maps", by Professor S.P. Chatterjee, was a unique contribution for its time. A similar effort was made by G. S. Ghosal, who produced an Atlas – “Punjab in Maps". Map and atlas-making exercises got a head start after 1958, after the publication of the Regional Planning Atlas of Mysore by ATA Learmonth and L. S. Bhatt. Though a

sponsored project of the Planning Commission, the latter paved the way for several subsequent Planning atlases like Manzoor Alam's Planning Atlas of Andhra Pradesh, followed by a Planning Atlas of Uttar Pradesh by L. R. Singh. During the last quarter of the last century, a few thematic Atlases were produced by geographers. The Tribal Atlas of India by Moonis Raza and Aijazuddin Ahmad, the Atlas of Women and Children by Saraswati Raju and the Atlas of Chandigarh by Gopal Krishan readily come to mind. However, the Historical Atlas of India and Pakistan by Joseph Schwartzberg is a world apart.

Nevertheless, it is a cartographic *piece de resistance.* Some publishers, notably Oxford University Press, have produced a few India-centric atlases. Besides the Oxford School Atlas, which has gone into multiple editions: they also produced an Economic Atlas of India and, lately, the Oxford Reference Atlas. Going beyond its traditional brief, the Survey of India, under the directorship of Dr Prithvish Nag, has produced a series of District Planning Maps of a large number of districts of India on a scale of 1:250,000. These large-scale planning maps make a good starting point to have one familiarised with any region.

Contemporary Works on the History of Cartography

In this context, mentioning a couple of works on the History of Cartography is essential. The three authors that must be acknowledged are Professor Joseph Schwartzberg, the celebrated author of "Historical Atlas of India", Susan Gole, and Manosi Lahiri, the last, a hard-core geographer and cartographer. All three have contributed to the History of Indian cartography in their ways. While Schwartzberg wrote several articles for the History of Cartography Project, Gole and Lahiri produced a collection of Indian maps from the archives and made them available to those interested in Indian maps. Gole started with "Early Maps of India" (1983), followed by a companion volume ", India within the Ganges", consisting of a series of early printed maps of India in facsimile and the edited volume of the "Maps of Mughal India" drawn by Col. Jean Baptiste-Joseph Gentil, referred to earlier. The most well-known work of Gole is her - "Indian Maps and Plans- from Earliest Maps to "(1983), followed by a companion volume ", India within the Ganges", consisting of a series of early printed maps of India in facsimile and the edited volume of the "Maps of Mughal India" drawn by Col. Jean Baptiste-Joseph Gentil, referred to earlier. The most well-known work of Gole is her "*Indian Maps and Plans - from Earliest Maps to the Advent of European Survey*". Gole could find and put this collection of all the maps and plans in a volume. Manosi Lahiri (2012) - "Mapping India" is a collection of 160 annotated coloured maps. Running 320 pages, the book, more like an atlas, could be considered the latest addition to the History of Indian cartography.

Where is Indian Cartography?

There is no breed of professionals in India called cartographers. In some countries, there is a class of qualified, trained cartographers called "Cartographer Engineer", and university departments and other Government organisations hire these cartographers. No university in India, to my knowledge, offers a course leading to a degree or diploma in cartography. The second most important point is that India does not produce maps of any other continent or country or a world atlas of some merit besides its own. The country depends on international publishers, like Oxford, Phillips or others, for an atlas. Nor does the country produce medium-scale maps (1:200,000 or 1: 1,500,000) of different countries or parts of the world. The most readily available map of any part of the world is the million sheets of international series on a 1:1,000,000 scale. Whatever the past achievements or non-achievements of Indian Cartography, the state of map-making in India today is a sad commentary on contemporary Indian cartography. What is needed is a revival of cartography on modern lines by establishing a multi-functional Institute of cartography to preserve past cartographic works from all possible sources, train a band of cartographers on scientific lines and produce maps of all parts of the world, including India.

Contemporary Cartography in India

Besides the Survey of India, the country's premier producer and keeper of maps, the most visible cartographic organisation in India is the Indian National Cartographic Association. It holds annual conferences, often hosted by some geography departments or other Indian universities. If one exists, finding a cartography department in any university in India is not easy. To question if there are any acclaimed cartographers in India may bring a negative answer. What has been known for a long is the interest and profession of geographers as makers and users of maps. Map-making has been integral to geographical teaching in Indian colleges and universities. Unfortunately, with the advent of Remote Sensing and Geographical Information Systems, the actual map-making has receded in the background. Copying, often from unauthorised sources, digitising and use of available software have made map-making exercises redundant.

Google's over-arching reach

The appearance of Google Maps has charmed and stunned every user of maps. On needing a map, one turns to Google, not some atlas with a gazetteer or a topographical sheet. To be fair to Google, a private entrepreneurial enterprise, it has done tremendous work not only as a search engine but also by producing Google Earth with multiple layers of information and building built-in programmes for scale adjustments, carrying some basic information that pops up the moment you touch a location on the map. These maps have packed in so much data usually unavailable from a simple map. Distances, heights, and relief profiles are integrated into a Google map. The fallout is that with a laptop or a smartphone, one can scan enough information about a place or a region. A person with a smartphone will tell the coordinates, the height, distances and many other details in a few seconds, whereas in an atlas, one has to look at the gazetteer, given at the end, to know the coordinates, estimate the height with the help of the nearest contour, or measure distances on the map by using the scale. Google has integrated software in Google Maps that do these simple jobs at electrifying speed.

However, these devices or facilities represent only a part of the entire gamut of cartographic work. It must be remembered that Google has utilised survey maps, topographical sheets, atlases, and other details for identification, processed them, subjecting them to software that produces multilayered maps, which are handy. The satellite images are their own or obtained from national agencies, but other details, especially the identification of ground features, must have been obtained from some maps. For example, how would Google know the name of a village, say Chak -179, in Punjab from a satellite? In such cases, these agencies have to depend on secondary sources. It is hard to imagine that Google has employed human resources to cover the entire face of the earth, survey, and complete the identification exercise. How would the satellites know the names of the ground features? Again, these must have been borrowed from secondary sources, regional, local or city maps, or done through human resources identifying and inscribing names.

Secondly, Google’s achievements do not make our country proud. That is the success story of a Commercial enterprise with its base in the USA. Google borrows heavily on the centuries of accumulated work of engineers, surveyors and cartographers to collect information, process it and present it to us as a ready MENU to be used freely by anyone. The country and its geographers have not produced a standard geographical atlas, nor is there any publishing house of Indian origin that has undertaken this specialised task of map and atlas making. Oxford, for long specialised in atlas making, is still the best producer of atlases. Their school atlas, for a modest price of Rs 150/-, is the best in its class.

The fact is that though the Government of India is very strict about adhering to a pre-established authenticated international boundary, cartography, as an art and science, has suffered complete neglect. Therefore, the Government of India must think of an Institute of Cartography to train and prepare cartographers trained in all aspects of cartography.

In light of the above discussion, one may pose a few questions:

1. Is GIS and Remote sensing a substitute for cartography?
2. Can we do away with the Science and Art (the aesthetics involved) of cartography?
3. Is it not the function of cartography or cartographers to produce good maps and atlases, thematic and topographic, taking necessary inputs from GIS and Remote Sensing?
4. Why have Indian cartographers, including those specialised in GIS and Remote Sensing, not produced a District, State and Country atlas of the mountainous and highly inaccessible areas by applying the knowledge of GIS and Remote Sensing?
5. I believe cartography is the Art and Science of map making, and GIS and Remote Sensing are the scientific tools for spatial analysis.
6. Let the scholars, especially geographers, who have been traditional makers and users of maps, produce some maps and atlases of our country or any part of the world, using their expertise. Let cartography not disappear from the scene altogether.
7. The freely available geo-platform of 'Google' with layers of details at different scales for consultation is neither our creation nor can these be printed as an atlas, which is akin to plagiarism and may be interpreted as an infringement of Copy Right Act. Also, as mentioned above, Google is not an Indian creation.
8. The 'Bhuvan' Geo-platform, made thankfully available by ISRO, is some consolation. However, it hardly compares with the quality of Google. Besides having limited coverage, unlike Google, which has a global reach. The main question, however, remains: Does it eliminate the need for map-making? If the maps produced in the Indian research journal are any guide, I dare observe that a large number of Indian geographers, if not all, shabbily adopt the spatial details from Google or somewhere else. These maps lack clarity.
9. Those interested in map-making may seriously consider an Institute of Cartography, as mentioned above.

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