This chapter traces the establishment and growth of some scientific institutions in South India. The pride of place is however given to the Madras Observatory and the University of Madras (both located in the city of Madras (now Chennai) along with some of the colleges affiliated to the latter. We briefly touch on other universities of that period in the South too. We also offer brief sketches of the formative years of some of the major scientific figures who came out of these institutions. The chapter closes with some comments bearing on the sociological and colonial context in trying to answer some of the questions that arise from our study.

In this essay we plan to address the following issues one after the other in separate sections.

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The colleges where 'all the action was': II. The Arts and Science Colleges
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Introduction and the pre-colonial past

The British are often credited with having been more benign colonialists than their European rivals. One of the main reasons for this is that unlike other European powers, they founded socio-cultural (as well as political) institutions in the subcontinent. There is no doubt that there is some truth in this, but it must be pointed out that India (unlike some other areas colonised by the Europeans) had a long tradition of institutionalised intellectual and cultural activities of a high degree of sophistication.

The turbulent history of the eighteenth century and the first half of nineteenth century saw the consolidation of British power in India. The inadequacies of the subcontinent's indigenous military prowess inevitably had its repercussions on its socio-cultural life as well: there was a loss of confidence in the traditional mechanisms and institutions which went into decay as a consequence. Nevertheless the new ones which replaced them (imitative of British models) could not have succeeded without that background of indigenous experience in building institutions.

The history of organised intellectual activity in the Tamil country goes back to the beginnings of the Christian era or earlier with the advent of the so
called ‘Sangam’ literature. The most ancient Tamil literary work that has survived from that distant past is Tolkappiam, a comprehensive treatise on Tamil grammar – a clear indication that the language already had a substantial body of work to warrant a detailed analysis of its structure. Tolkappiam as well as the later ‘Sangam’ works display a sophistication comparable to that in any contemporary civilisation. The ‘Sangam’ was a kind of elite academy not unlike modern literary academies; to be admitted to the ‘Sangam’ was the ultimate recognition accorded to the Tamil poet or savant. Tradition has it that there were three ‘Sangams’ at different periods of time, when creativity reached great heights, the intervening years being somewhat barren, the last one being in the beginning of the Christian era. ‘Silappadigaram’, one of the epic poems in Tamil is supposed to be a product of the ‘Sangam’ age or soon after though (as with many other literary works) the dates assigned by tradition – first century CE – are not substantiated by other historical evidence. This epic poem is remarkable in that unlike most other epic literature of the world, its heroic central character is a commoner, not of royal blood, and a woman at that.

The subcontinent was of course no stranger to structured intellectual activity in the sciences as well. Taxila and Nalanda were great centres of learning, functioning more or less along the lines of modern universities with a wide spectrum of disciplines including the sciences from early on. In the South, there were Kanchi and Amaravati where great academies flourished. Mathematics and astronomy are two areas which were pursued at their frontiers by Indian scholars; and an Arya Bhatta or a Brahmagupta was second to none in their creative genius. However the South, its outstanding tradition in literature and philosophy (the great Buddhist philosopher Nagarjuna is from the Andhra region) notwithstanding, does not seem to have paid much attention to the sciences until the beginning of the second millennium after Christ (unless one treats the study of grammar as science). During the 14th to 17th centuries, a great mathematics school flourished in Kerala in the neighbourhood of present day Calicut. Madhava (1350 –1425 CE), the biggest name of the school had in an essential way in fact anticipated the Calculus some three centuries before the mathematicians Isaac Newton(1643-1727) and Gottfried Leibnitz(1646-1716). Intellectual activity however declined over the next few centuries which was a period of endemic political instability. The first stirrings of a revival of interest in academic pursuits had to wait for the stability provided by the consolidation of British power in the subcontinent.

This essay traces the establishment and growth of some scientific institutions in South India during the colonial period. Two institutions, the Madras Observatory and the University of Madras, both set up under British patronage in the Madras Presidency, which played major roles in the evolution of scientific activity in British India, are given the pride of place in this account. The Madras Observatory began as a private initiative of an employee of the East India Company while the university came into existence through a formal governmental exercise. For a long period after its inception, the observatory functioned mainly to provide inputs for practical concerns such as surveying; nevertheless it served as a nucleus for the start of basic scientific research activity in the subcontinent. During British rule it was largely the preserve of British scientists with a few Indians carrying out the bidding of their European bosses. The institution contributed only marginally towards educating Indians.

In contrast, the objective of the University of Madras was the promotion of higher education (not exclusively science education) among the Crown's subjects in the South; even if that education was geared only to generate human resources for the subordinate civil services. Scholarship for its own sake and research, especially in the sciences, did not figure in the government's plans. Almost all the teaching was done in the 'affiliated colleges' rather than in the University Research Departments which in any case were started long after the university came into existence. It is the affiliated colleges, both in the city of Madras and in the other cities of the South, that were the real academic centres and in time these produced outstanding mathematicians and scientists. We sketch brief portraits of some of these major figures focussing on the features of the academic institutions that moulded their scientific future.
Madras University was historically the first university in the South. A few others universities were created in the twentieth century during British rule. Those in the South were (with one exception) modelled on Madras University and were created to share its responsibilities in the wake of the rapid expansion of the demand for higher education. In their early days they were (necessarily) staffed largely by the products of Madras University which can therefore lay some claim to have been the mother of all of them.

The fascinating story of the Madras Observatory

There are four significant streams of scientific, technical and educational activities that originated from the Madras Observatory: astronomy that gave rise to the Kodaikanal Observatory and the Indian Institute of Astrophysics (IIA) at Bangalore, geographical survey of the Indian Subcontinent from Kanyakumari to Mount Everest called the Great Trigonometrical Survey (1802-66) (more on this later in this section), technical education that led to the formation of the Survey School which became the Guindy Engineering College (see separate chapter on that institution in this volume) and finally meteorology, the only activity that survives in the present-day avatar of the Madras Observatory, namely the Regional Meteorological Centre.

Our story starts with William Petrie (d.1820), a Company servant from 1765, who pursued his hobby of gazing at the stars in the garden of his house in Egmore (a locality in Madras). Petrie's private observatory had provided a reference meridian for the coastal survey by Michael Topping (1747-96) which led to the first modern astronomical records in India, beginning 5 December 1786. Topping, the Chief Marine Surveyor and the first full-time modern professional surveyor in India, arrived in Madras in 1785 and, from the beginning, worked with Petrie's instruments. One of Petrie's instruments, a pendulum clock made by John Shelton (1712-77) was identical to the one used by the famous Captain James Cook (1728-79) in one of his voyages to the South Seas; it was long used in the Kodaikanal Solar Physics Observatory.

Petrie gifted his instruments to the Company before he left Madras. The Company asked Topping (who was already Chief Marine Surveyor and was also to become Superintendent of the Survey School which the Observatory tended from 1794 to 1801) to additionally officiate as the Company's astronomer. Edward Garrow's 'Garden House' in Nungambakkam, near Egmore, was acquired by the Company in 1791 and Topping moved in. In the grounds of this new residence-cum-office of his, Topping built the observatory in 1792. This move from Petrie's house to the Nungambakkam premises and the establishment of the first official observatory in Colonial India in 1792 is commemorated in the garden of these premises by a 10-ton 15-foot tall granite pillar, unveiled by Sir Charles Oakley (1751-1826), the then Governor (1790-94) of Madras Presidency in the same year.

In January 1794, Topping proposed that a Surveyor-General's Office be instituted at Madras, with two European Assistants and ten or twelve Practitioner Surveyors, the latter to be selected from English schools and trained in practical surveying. The Board of Revenues supported the proposal and advised Topping to select a suitable number of boys. He selected accordingly eight boys from the Fort Charity School. On 17 May 1794, Mr John Goldingham FRS (1767-1849), assistant of Mr Topping, was informed by the President-in-Council that he could go ahead with the proposed training of the selected students in surveying. Therefore 17 May 1794 is the date of the founding of the Survey School which developed into the college of engineering whose story will be taken up later.

Goldingham, who had served as Petrie's and later as Topping's assistant, succeeded Topping in 1796 and was designated the first official Astronomer. He determined the latitudes and longitudes of several Indian locations, including the first assessment of the longitude of Madras (80° 18' 30" E). William Lambton
FRS (1756-1823) who in 1802 started the Great Trigonometrical Survey\(^2\) of India from St Thomas' Mount (a low hill in Madras), linked his 7.5 mile baseline with the Madras Observatory, which is considered the secondary meridian, the meridian that can be substituted for the prime meridian, Greenwich. By the end of the tenure of Sir George Everest\(^2\) FRS (1790-1866) as Surveyor General of India in 1843, the great meridianal arc had moved across a vast area of the subcontinent. But the starting point for this stupendous task was Lambton's baseline of St Thomas Mount to Madras Observatory.

The giant pillar, on which there was once a 12-inch altitude and azimuth instrument, believed to have been Petrie's and the first in India, has an inscription on it, and this is the oldest benchmark in Asia. The inscription, in English, Tamil, Telugu, Urdu and Latin, believed to have been cut after the astronomer Michie-Smith\(^2\) (1854-1922) had made the final longitudinal determination of Madras in 1892, reads: 'The geodetic position (Lat 13° 4' 3.5" N, Long 80° 14' 54.20" E) of Col William Lambton is primary original of the Survey of India. Fixed by him in 1802, was at a point 6 feet to the south and 1 foot west of the centre of the pillar. The centre of the meridian circle of the Madras Observatory was at a point 12 feet to the east of the centre of this pillar'.

A more permanent observatory was built at the site in 1845. In the campus there are 4 more granite pillars, one dating to 1792 and three to 1860. These pillars were meant for transits and standard clocks. In its early years, the Madras Observatory set the standard time for all India and this continued for quite a while. There are residents of Madras who still remember that a time-gun used to be fired at 4 PM daily from Fort St George, which was directly connected to the standard clock in the Observatory. And this clock gave India its Standard Time in those days!

At this Natchathira Bangala (Star Bungalow), where a white hemispherical dome housed the telescope, several notable astronomical discoveries were made over the years. Among them was the first modern astronomical discovery by an Indian - the discovery of the variable star 'R Reticuli' by Chinthamani Ragoonatha Chary (1840-80) in 1867. This was during the observatory's brightest era, that was undoubtedly the period 1861-1891 when Norman Robert Pogson\(^2\) (1829-91) (who introduced the yardstick called ‘magnitude’ to measure the brightness of stars) was the Government Astronomer. Chary's contributions here were numerous and included his attempts to wed Indian and Western astronomy and his work on the Transit of Venus. Another illustrious incumbent here was Thomas Glanville Taylor (1804-48), whose Madras catalogue, the first Southern Hemisphere Catalogue (described by the Astronomer Royal (1836-1892) Sir George Airy\(^2\) (1801-1892) as 'the greatest catalogue of modern times') listed the positions of 11,015 stars and formed the basis of the British catalogue.

After Pogson's death in 1891 the decision was taken to move the Observatory to Kodaikanal. The move was made in 1899. The Nungambakkam Centre was left to meteorology which had begun here in 1875 and it continues to serve as the Regional Meteorological Centre to this day. The Meteorological department was in charge of the Kodaikanal Observatory till the Indian Institute of Astrophysics (IIA) was inaugurated in 1976.

Since its inception the Kodaikanal Observatory was almost entirely engaged in research on the sun, for conditions in Kodaikanal for solar observations were excelled at few, if any, of the observatories in the world. The research programmes included the study of the physical condition of the sun, solar disturbances and solar atmospheric phenomena in general. It had highly specialised instruments not to be found anywhere else in India. The pride of place belonged to the spectroheliogragh, which John Evershed\(^2\) (1864-1956) FRS perfected into the finest instrument of its kind in the world. It took regular spectroheliograms in both the Calcium and Hydrogen spectral lines.

The Kodaikanal Solar Physics Observatory became a part of the IIA set up in Bangalore in 1976. However, one of IIA's main observational facilities, the
Vainu Bappu telescope\textsuperscript{26} is at Kavalur, Javadi Hills, and more recently a very high-altitude telescope (perhaps the world’s highest telescope) was set up by IIA at Hanle in the Ladakh region of the Himalayas. Thus, clearly, the present Indian Institute of Astrophysics is the successor to the Madras Observatory.

In spite of all this, we must now mention the negative side. None of the early work in astronomy entered the educational system, either the colleges or the universities in the country. That is where the subaltern character of the whole enterprise becomes manifest. Whatever contributed to the immediate aims of the colonial government, such as surveying, was supported and developed, the rest was only tolerated. Even astronomy developed first only as an offshoot of survey activities and even later it was considered only as a subordinate affair to the astronomical researches in the United Kingdom. So there was no effort at all to train astronomers through instruction in the colleges and the universities here. The effects of this serious lacuna are felt even today. The modern astronomical programmes in India suffer from serious lack of manpower. Not only that, even the mindset of our present-day educational administrators has not changed much; we still do not have a reasonable number of programmes for astronomy education in our universities!

The Madras University\textsuperscript{27}

Educational initiatives sponsored by the British seem to have appeared on the scene in Madras already in the seventeenth century – the East India Company had on its payroll a schoolmaster, Ralph Ord.\textsuperscript{28} In 1717, the company established a school in Cuddalore. Missionary activity had spawned many schools in the British territories in the south already in the late eighteenth century and their number increased rapidly after the British Parliament passed the Charter Act\textsuperscript{29} of 1813 when missionaries were allowed to function freely. In 1813, the company earmarked a sum of 10,000 pounds ‘for the promotion of learning’. But these institutions were devoted to elementary and sometimes secondary levels.

Some institutions devoted to scholarship and higher learning had also been sponsored by the British already in the eighteenth century. The Asiatic Society founded in 1784 by William Jones\textsuperscript{30}(1746-1794) under the patronage of Warren Hastings (1732-1818), the first Governor General (1773-85) is no doubt the pre-eminent example. Warren Hastings himself started a College\textsuperscript{31} for Persian Studies in Calcutta while Jonathan Duncan (1765-1811) established a College\textsuperscript{32} for Sanskrit studies in Benaras (now Varanasi) in 1791. These were attempts indicating an interest in traditional Indian scholarship. The Asiatic Society initially catered mainly to Europeans seeking to learn about India.

Bigger changes came with Bentinck\textsuperscript{33}(1774-1839) and Macaulay\textsuperscript{34}(1800-59). Until this time, even while institutions were set up, there was no well formulated government policy on education. Debates on whether education should be in tune with the subcontinent’s own traditions or should be along occidental lines with English as the medium of instruction had come to an end with the Macaulay school of thought – favouring the ‘superior’ British system – prevailing. The famous Macaulay Minute\textsuperscript{35} of 1835 on Indian Education set the scene for rapid changes and developments that were to take place in the next hundred years and more of British rule.

The South – or the Madras Presidency – saw the establishment of more schools along Western lines, many of them by missionaries even while the Company itself also set up its own schools. In 1836 Lord John Elphinstone (1807-60), Governor of Madras Presidency (1837-42), had a number of resolutions on education passed by ‘The Committee on Native Education’ whose gist\textsuperscript{36} was as follows: ‘That it is expedient that a Central Collegiate Institution or University should be established at Madras. The Madras University to consist of two principal departments, a College for the Higher Branches of Literature, Philosophy and Science, and a High School for the Cultivation of English Literature and of the vernacular languages of India and the elementary departments of Philosophy and Science’.
The resolution was welcomed by the ‘Native Inhabitants of the Territories under the Government of Fort St. George’ in a Public Address\textsuperscript{37} to the Governor of Madras in the year 1839. It was signed by an unprecedented (in the annals of the east India Company’s Rule) 70,000 people. The address urged the Governor to implement the resolution expeditiously. It goes on to point out that collegiate institutions had already been established in other British territories by the Company administration even while they, the inhabitants of the oldest of the British possessions in the subcontinent were yet to be provided access to higher education.

‘The people of this presidency’, asserts the document, ‘are not without their claims on the promoters of the cause of Native Education throughout Europe and especially on those of the English nation. The Madras Native System of Education have given its name to a method of instruction which, we are told, has contributed to benefit mankind’. The reference to the ‘Native System’ suggests that the educational institutions predating the advent of the British were not entirely forgotten. That the document should have been signed by as many as 70,000 people is indicative of widespread interest in higher education among the public as also a capacity for organisation for the cause.

The proposals took shape in 1840 with the opening of a ‘preparatory’ school with a Mr. Cooper from Hooghly College, Calcutta as the (temporary) headmaster. Later in the year Sir Eyre Burton Powel\textsuperscript{38}, a Cambridge Senior Wrangler (in mathematics) was appointed headmaster of the institution which was in essence a high school. In 1853, it underwent further reorganisation and a separate collegiate department was established. In 1855, the collegiate department was brought under the purview of the then newly formed Department of Public Instruction and acquired its present name which is ‘Presidency College’. The college was in fact referred to as a ‘university’ in some government documents, but in 1857 a separate body called Madras University was founded by an Act of the Legislative Council of India dated 5 September 1857 (following a resolution of 1853 and a recommendation of the ‘Despatch’\textsuperscript{39} of 1854); it is remarkable that this initiative was taken even as the Company was engaged in a battle for its very survival in the North. In any event, Presidency College must really be considered as the precursor of Madras University; in fact for some seventy five years after the founding of the university, it was that college and other ‘affiliating’ institutions, not the university, that were fulfilling the functions of educating students and pursuing superior levels of scholarship that are expected of a university. Even today all undergraduate teaching and most of post-graduate teaching is handled only by the affiliating institutions, the university limiting itself to post-graduate teaching and research.

The mandate of the university when it was set up was to be an examining body which would award degrees to the students trained in the affiliating institutions. It was also to scrutinise the credentials of the institutions seeking to affiliate themselves to it and grant affiliation only to those measuring up to the norms that it was to set. The University of London served as the model. The first entrance examination of the university, called Matriculation, was held in September 1857; 41 candidates appeared and 36 passed. Initially the university awarded only one degree – B A, the Bachelor of Arts. The first examinations for that degree were held in 1858; only two candidates, both from the American Missionary Seminary of Jaffna, Ceylon, appeared and both were awarded the degree the same year. The F A or the First Examination in Arts, between the Matriculation and the B A or the Bachelor of Arts was introduced only in 1863-64 and this was later renamed as the Intermediate Examination. The M A (Master of Arts) came a little later. Even for science subjects the degrees awarded were the B A and M A.

The introduction of a three year programme (in 1911) leading to the degree B A (Honours) proved to be a very good step towards the promotion of excellence. Two years of the Bachelor’s course and two years of the Master’s were compressed into three years of Honours. The Honours course in a given subject was offered
only at colleges selected carefully by the university and the number of students admitted was also extremely restricted. The programme was naturally more challenging than the pedestrian progression to an M.A. degree through the B.A.; it quickly gained prestige and attracted brilliant students. The B.Sc. (Bachelor of Science) degree came to be instituted later along with the corresponding Honours degree. Unfortunately the excellent Honours programme was discontinued after 1957; the last examination was held in 1960.

Presidency College was the first institution that was accorded affiliation. Students trained there were to take the F.A. and B.A. degree examinations conducted by the university. Other colleges were to follow suit. Among the early colleges affiliated to Madras University mention may be made of the Madras Christian College, the Central College of Bangalore and the Maharaja's College (now called University College) of Trivandrum (now Thiruvananthapuram). Some of the other colleges that established for themselves a high reputation were the Government College of Kumbakonam (which was sometimes referred to as the Cambridge of South India by its alumni), St. Joseph's College, the National College in Trichinopoly (now Thiruchirapalli) and Loyola College in Madras. Colleges founded in many towns in the then Madras Presidency as well as in the neighbouring princely states sought and obtained affiliation from Madras University. It is these colleges that were centres of higher learning.

During the period 1857-1947, the number of affiliated colleges grew rapidly from 10 to 130. The number of students too increased from just 43 in 1857 to 30,000 at the time of independence. There were some decades during which there was a decline in the number of affiliating institutions as well as the number of students. This was essentially the result of the creation of new universities which resulted in limiting the geographical areas under the jurisdiction of the University of Madras: other universities catered to the areas that were beyond the jurisdiction.

Applied science at a fairly advanced level in the form of engineering and medicine was already being taught in some institutions before the advent of these colleges. But it is with the starting of the Presidency College and other colleges affiliating to the University of Madras that science came into the fold of higher ‘liberal’ education. Understandably many of the early teachers in the sciences as well as the humanities were Westerners, mostly British, though there was a sprinkling of other nationalities especially in the Christian missionary institutions. The first Indian principal of Presidency College was appointed only in 1943.

The Colleges ‘where all the action was’: The Professional Colleges

The Engineering College, Guindy

The college of Engineering owed its inception to Michael Topping, the Government Astronomer and Chief Marine Surveyor whom we have already encountered in the section on the Madras Observatory and who was in fact responsible for the creation of that observatory. It was due to his efforts that a Survey School was founded in 1794 which ultimately developed into a college of engineering. But there were many ups and downs before that was accomplished. Due to financial depression, the recruitment of boys for the Survey School was in fact suspended in 1810 and reopened only in 1819.

In 1842, the inadequacy of the Survey School was recognised and it was proposed to establish a College of Engineers, within the so-called Madras University which was yet to be established. The institution was designed to train officers of the line as engineers and civilians as Upper-Subordinates. This proposal was negated by the Court of Directors of the Company in 1843 on the ground that the condition of general education in the Presidency was not sufficiently advanced to warrant the establishment of a college for professional subjects. In 1847, the Home Government concurred with the Government of India and revived the
question of starting the college of engineers, and referred the matter to the Madras Public Works Commissioners, who in turn recommended the establishment of a college at Madras on the model of the college founded at Roorkee in the same year.

Meanwhile, Major Maitland was running a school unaided by the government for ordnance artificers and apprentices in the Gun Carriage Factory. He considered that each student should be a perfect master of at least one trade before admission into the Engineering College. In 1854, the Governor-General Lord Dalhousie (1812-60) proposed that 'whether by the extension of Major Maitland's School or by its incorporation with a large institution upon the principle of the Thomason College at Roorkee, a complete system of instruction shall be provided at Madras for every class belonging to the FWD, Europeans, East-Indians or Natives, whether artificers, foremen, overseers, surveyors or civil engineers'.

This should have settled the issue, but it did not. Mr A J Arbuthnot, who was the Director of Public Instruction (DPI) was called upon to submit proposals for the establishment of the Engineering College. He questioned the expediency of taking Maitland's School of Carnatic Ordinance Artificers as a basis for the proposed institution. Major Maitland maintained that the orders of the government were to be construed as conferring on him the sole discretion of the projected college. A voluminous correspondence ensued. Meanwhile, the Survey School was enlarged and a Principal was appointed. In 1857, Lt G Winscom, who was the principal, went to Calcutta to examine the system followed in the Civil Engineering College in Calcutta. In 1859, Arbuthnot and Winscom submitted a revised scheme, based on the Roorkee model. This required increased expenditure, but the Government of India was unwilling to support any expenditure beyond what the Survey School incurred.

From 1 September 1859, the Survey School came to be called the Civil Engineering College and it functioned in a portion of the palace of the late Nawab of Carnatic at Chepauk, on a moderate scale. On 15 June 1860 Captain Carpendale succeeded Captain Winscom as Principal. In 1877, the college was affiliated to Madras University. In 1894, the University instituted a Degree in Mechanical Engineering and the B C E was changed into the B E Degree. The Madras University was the first in India to institute a degree in Mechanical Engineering. The college was shifted from Chepauk to its present premises in Guindy in 1920. The degree course in Electrical Engineering was started in 1930. Degree courses in Telecommunication Engineering and Highway Engineering were introduced in 1945. Among the first graduates of the college in Telecommunication was the distinguished computer scientist Rangaswamy Narasimhan (1926-2007) who designed India's first general purpose digital computer and is regarded as the doyen of Computer Science in the country. Anna University started in 1978 with the Guindy Engineering College as its main constituent institution.

**Madras Medical College (MMC)**

The history of the Madras Medical College is tied up with that of the Government General Hospital in Madras. That hospital was established on 16 November 1664 as a small infirmary to treat the sick soldiers of the East India Company. The initiative for creating this first British hospital in the Madras Presidency came from Sir Edward Winter (1622-1686), a Company Agent (1661-1668). In its early days, it was housed at the Fort St George and in the next 25 years, it grew into a formal medical facility. Sir Elihu Yale (1649-1721), the Governor (1687-92), gave it new premises within the Fort in 1690.

The Hospital moved out of the Fort after the Anglo-French War (1751-54) and it took 20 long years before it could settle in the present permanent place in 1772. By the year 1772, the hospital was training Europeans, Eurasians and some Indians as well in Allopathic methods of diagnosis and treatment and methods of preparing medicines. These trained personnel were posted to various
dispensaries in the district head-quarters of the then Madras Presidency to assist the qualified doctors. By 1820, the institution had the recognition as the model hospital of the East India Company. In 1827, a Dr D Mortimar was appointed as the Superintendent of the Hospital.

The college started off as a private medical hall run by Mortimar, and was regularised into a medical school in 1835, which was opened by Sir Frederick Adams (1781-1853) who was Governor of Madras (1832-37). The governor then promulgated an ordinance by which the school was attached to the Government General Hospital and was sponsored by the state. The object was to make the Medical Subordinates more efficient in the performance of their professional duties and to give them a more systematic course of study and training. The School which operated from temporary quarters shifted to new premises in 1836. The teaching staff consisted of 4 persons (2 British officers, the Superintendent and Assistant Superintendent and 2 Indian Assistants). The course was for 2 years and the curriculum contained anatomy, materia medica, medicine and surgery. Soon, 3 additional professorships were sanctioned of Anatomy and Physiology, Midwifery and Ophthalmology and Chemistry. The duration of the course was also extended to 3 years.

In 1842, the hospital opened its doors to Indian patients. By 1850, three streams of courses were run: private and stipendiary students who had a 5-year course, apprentices qualifying for the Apothecary grade, after a 4-year course and pupils qualifying for Second Grade Dresser of the Medical Department, with a 3-year course. In the same year the School was accorded the status of a college by the government and renamed as the Madras Medical College. The first batch of students graduated in 1852 and were granted the 'Diploma of Graduate of the Madras Medical College'. When Madras University was established in 1857, it was intended that the liberty of granting diplomas should be restricted to the university. In 1863, the government ruled that no student would be granted diplomas by the college and that all who wished to obtain academic degrees must pass the University Examination in the Faculty of Medicine.

Thus started a new era in the history of MMC. Hitherto the institution had signally failed to draw into the ranks of the profession educated Indian youths in anything like the numbers that were attracted by the legal and other professions. Once the university assumed the role of issuing the diplomas and degrees, a better day dawned for Medicine. Better educated youths were encouraged to enter the profession and the college saw larger and larger numbers of private students joining every succeeding year. In 1875, women students were admitted to the Medical College for the first time, an innovation at a time when no other Medical College in India was open to women students, when even in Great Britain the admission of women students into medical colleges was a controversial subject.

Together with the Guindy Engineering College, the Madras Medical College formed the strong science-related professional colleges of Madras University. Most of the leading medical practitioners of Madras Presidency graduated from MMC. The first lady doctor in the English speaking world and the first Indian lady doctor were both graduates of MMC.

The Colleges ‘where all the action was’: The Arts and Science Colleges

Presidency College

Presidency College, Madras, has the unique distinction of being the oldest institution of higher learning in South India. As was mentioned earlier, its origin is to be traced to the ideas of Lord John Elphinstone. His plan, in greater detail, envisaged the following advances:

The establishment of a Central Collegiate Institution or University of Madras;
the ‘University’ was to consist of two departments, a College for Higher Education in the different branches of Literature, Philosophy and Science and a High School for the cultivation of English literature and the principal languages of India and the elements of philosophy and science;

the college was to be under a Principal and Professors, and the High School under a Headmaster and tutors;

admission was to be open to all irrespective of creed or race, and there was to be no instruction in any particular religious faith or doctrine;

English was to be the medium of instruction.

These and other proposals for the administration of the college and the High School were accepted by the Governor-in-Council in January 1840 and the first Governing Body was set up with George Norton, Advocate General of Madras, as chairman. The high school opened in Egmore (located in the north-western part of the city of Madras) on 14 April 1841. In his inaugural address, Lord Elphinstone said: ‘The High School which is now opened is intended to lead to a superior course of study to any which has been hitherto attempted in this Presidency. In due time it is hoped that it will be possible to train a sufficient number of young men for the prosecution of a collegiate education’. E B Powell assumed charge as Chief and the School started with 67 pupils.

In April 1852, Sir Henry Pottinger (1789-1856), the then Governor of Madras (1848-54), directed the Governing Body to implement the rest of the Elphinstone plan by the setting up of a collegiate department and later sanctioned the proposals of the Governing Body overruling his Council’s objections over the heavy expenditure involved. He also transferred authority over the institution, to the newly started Department of Public Instruction. The institution was also given for the first time the name of Presidency College. Powell was both the first Principal and the first Professor of Mathematics and Natural Philosophy.

When the University of Madras was created, Presidency College was directed to endeavour to bring up its courses of study into harmony with those which the university would prescribe. Accordingly Presidency College recast its courses of study. The High School classes were transferred to a new Normal School and Presidency College emerged as a full-fledged University College, with an additional year of study added to its existing 3-year course, leading to the B A Degree of the Madras University. The college had at this time six professors which included one Professor of Mathematics and Natural Philosophy and the rest were in the Arts. The college was shifted from Egmore to its present premises on the seafront when a new building (which continues to provide many of the lecture halls) was inaugurated by the Duke of Edinburgh in March 1870. Designed and built in the Indo-Saracenic architectural style by R F Chisholm (1838-1915), it is one of the beautiful buildings lining the Marina Beach in Madras. Its facade apart, here is what its greatest alumnus C V Raman (a student during 1902-06; see Section) had to say about the prospect from within:

The English classes were conducted by Professors Bilderbeck and Elliot. They had their classes usually in the big lecture hall overlooking the sea, and the seats were so arranged that if the students did not like the lecture, they could instead gaze at the far horizon of the blue sea or count the glittering waves as they crashed down on the beach. Did ever students of the English language have a more marvellous panorama the contemplation of the beauty of which could lighten their labours? I am almost tempted to compare it with the glorious theatre built by the ancient Greeks on the height of Taormina from which you could see the waves of the Ionian Sea washing the coast of Sicily, or turning your eye up, you could see the glittering heights of Mount Etna. It must be said to the credit of the teachers I have mentioned that they often did hold our attention in spite of the lure of the swirling waters of the ocean breaking upon the shore, or was it because of the same fascinating vision of the sea that our minds were better attuned to the complicated beauties
of the English language? I have vivid memories of the spirit with which Professor Bilderbeck conducted his classes and sought to infuse into us a due appreciation of the great English writers.

In 1874 a chair of Physical Sciences was instituted and Professor Wilson who had graduated from Heidelberg was appointed to it. In 1886 a chair of Biology was established, with Dr A G Bourne as the first Professor. In 1889 the Department of Physical Science was split and two professorships, one for Physics and one for Chemistry, were sanctioned. R L Jones was appointed Professor of Physics and Professor Wilson was designated as Professor of Chemistry. These two eminent scientists built up the two departments in their charge to a very high level indeed, each of them giving over 30 years of their service to the college. So this period marks the establishment of serious high-level teaching of Science for the first time in South India and paved the way for the appearance of stars, as we shall see in a later section. Presidency College has the rare distinction of counting two Nobel Laureates among its alumni, C V Raman and S Chandrasekhar.

Madras Christian College (MCC)

On 3 April 1837 the Reverend John Anderson, a missionary sent out by the General Assembly of the Church of Scotland, opened a school in Armenian Street in George Town, Madras and ran it till 1855. It is from this institution that the Madras Christian College was born in 1865. Among the subjects taught were English, Mathematics, Astronomy, Theology, Political economy and christianity.

The number of students increased rapidly, rising to 180 in about two months. The School became so popular that within a year new premises had to be found. After another 8 years, a building in Esplanade was bought. Meanwhile Anderson was joined by others from the Scottish Mission. The first boom in English education was to be followed by a second one of perhaps even greater significance. Anderson's highly successful programme was to be canalised into the ordered discipline of university studies. The University of Madras was founded in 1857 as an examining and affiliating body. It was left to the Reverend Dr William Miller (1838-1923) who arrived in Madras in 1862 to undertake the creative task of converting the school into a college.

Starting with Matriculation in 1865 and Intermediate in the next year, the first batch of students from the college went for the B A Degree in 1868. Then followed a period of rapid development under the inspired guidance and initiative of Miller. In 1877 the college was renamed as the Madras Christian College. Bold and brilliant innovation and experiment placed the college in the forefront of the institutions for higher education in the presidency. Miller gathered around him a group of brilliant and able men whose names are still household words in South India. New buildings were constructed in the Esplanade for the college and hostels for students also came up in the immediate neighbourhood. In 1909 Miller left for Scotland and the most creative period in the history of the college came to a close.

But many new developments took place in the next 40 years. First was the institution of the Honours courses in 1911 that took the educational standards of Madras University to a high level. Madras Christian College became an Honours College with excellent Honours Courses in Physics, Chemistry and many other subjects. As a consequence many eminent scientists came out later from the college such as the physicist E C G Sudarshan (b.1931). The second was the shifting of the college to Tambaram, 16 miles away from Madras in 1937. In Tambaram, MCC established itself in sylvan surroundings very different from its older home in George Town.

The nurture of mind and character, which is education in the true sense of the term, involves far more than mere acquisition of knowledge. Close personal contact between teacher and student, and among students, in an atmosphere which fosters all that is highest and best is an essential ingredient of true education. The move to Tambaram gave the college a great opportunity to pursue
this aim with increased vigour. Thus was born the Hall system which was unique to Madras Christian College, Tambaram. The Hall came to be all that the hostels had been and a great deal more. Not only the resident student but also the non-resident student was brought into the orbit of the activity of the Hall. There were three Halls, St Thomas, Bishop Heber and Selaiyur and they were as well-known as the college itself (if not more). Each non-resident student was attached to one of the Halls and the same for all the teaching staff. Thus the whole College was divided into 3 units. While most of the instruction in lecture room and laboratory remained a function of the college as a whole, the Halls were the centres for tutorials, literary and debating societies and many other activities. The interaction among students was much closer in the Halls than was possible in the college as a whole and each student developed an identity with a particular Hall.

Pachaiyappa's College

On 22 March 1794, Pachaiyappa Mudaliar (see later section below), whose name will always be treasured in the history of South Indian education, bequeathed his wealth for religious and charitable purposes. For sometime, however, the executors of the Will had ignored this provision. Eventually, the Supreme Court, by a decree created a body of Hindu Trustees to manage the estate. After setting apart a certain amount for religious charities detailed in Pachaiyappa's Will, all accumulations beyond that amount were diverted for educational purposes. The institution originally founded in January 1842 was the Pachaiappa's Preparatory School, which was raised to a High School in 1858.

In 1880, when Mr D M Cruikshank was the principal, Pachaiyappa's became a second grade college of the University of Madras and admitted students for F A. It became a first grade college in 1889 through the efforts of John Adam, the next Principal during the period 1884 - 1894. Pachaiyappa's College is perhaps the oldest college in the South established by private initiative. Although it did not contribute significantly to science, it had an Honours Course in Mathematics and so produced many teachers of Mathematics. The mathematical genius Ramanujan (see later section) was a student for a while, but discontinued for health reasons. The college counts many illustrious political personalities among its alumni.

Other Colleges

The Church of Scotland was only one of the many Christian Missions that set up educational institutions in India. The Society of Jesus in fact founded several colleges in South India. Among them the earliest was St Joseph's College started in the year 1844 by priests of the Society of Jesus (Jesuits) in Nagapattinam in Tamil Nadu State. In 1883 it was shifted to Trichinopoly, at that time the biggest city in Madras Presidency after Madras. The college acquired a high reputation early on. It was the only College in the southern districts which had Honours courses and it was much sought after by students from that region of the Madras Presidency. One distinguished alumnus it can boast of was G N Ramachandran (see later section), the distinguished biophysicist. A P J Abdul Kalam (b.1931 who was the President of India (2002-2007) is another. Reverend Father Bertram (1870-1936), a French Jesuit founded the Loyola College in Madras with the help of funds from the Society of Jesus in 1924 when he retired as the principal (1908-16) of St Joseph's College in Trichinopoly. The college later received support from the Pope as well as the provincial government. In 1927 it was permitted to offer the prestigious Honours courses in mathematics and economics. Its mathematics department acquired a formidable reputation and one of the professors in that department, Reverend Father Racine (see later section) was a major influence in Indian mathematical research.

The Jesuits set up several other colleges in many smaller southern cities, many of which rendered great service to the cause of higher education in the South. They did not however contribute particularly to science. Other Colleges...
that contributed significantly to higher education were The American College and Madura College both in Madura (now Madurai) and St John's College in Palayamkottai. The American College was founded by the American Madura Mission in 1881, while St John's was by the Church Missionary Society in 1878, although both had their beginnings as schools much earlier. Madura College grew out of the Government Zilla School which was established in 1856 as the outcome of the famous Education Despatch of 1854.

One indigenous initiative may be mentioned for just being that: the National College in Trichinopoly came into being in 1919, thanks to the efforts of three leading citizens of the Madras Presidency. The college became immensely popular very quickly, partly because it was perceived as a Hindu institution as opposed to the Christian St Joseph's College. Among the benefactors of the institution may be mentioned Dewan Bahadur S Rm Pethachi Chettiar, Zamindar of Andipatti, Dewan Bahadur S Rm M A Ramaswami Chettiar and the Thota Chettiar family. The first principal of the college was one K Ramnujachariar who had just retired from Pachaiyappa’s College, Madras.

The Research Departments – late entrants

Research Departments in science started rather late in the life of Madras University. Departments of Mathematics, Zoology, Biochemistry and Botany were established in the late 1920s, but the other departments had to wait for another 20 years.

Mathematics

University of Madras was one of the earliest to support modern mathematical research, with Srinivasa Ramanujan (see later section) as a Research Scholar. Unfortunately, the first attempt to form a Department of Mathematics with Ramanujan as the first Professor of Mathematics could not come to fruition due to the untimely death of Ramanujan in 1920, soon after his return from England. But not long afterwards, the department was, in fact, started in 1927 with R Vaidyanathaswamy (see later section) as the head. The department worked in close cooperation with that in Presidency College. Professor Ananda Rau (see later section) of that college along with Vaidyanathaswamy helped to establish the first research school of high standing in modern mathematics in the country. We elaborate more on this development in a later section. Later, in 1950, the Ramanujan Institute of Mathematics was established by Rm Alagappa Chettiar (see later section) as a private institute with T Vijayaraghavan (see later section) as the director. The Institute was taken over by the University of Madras in 1957 after Alagappa Chettiar's death. In 1967 the Department of Mathematics and the Institute were amalgamated to form the UGC Centre for Advanced Study in Mathematics and was named as the Ramanujan Institute for Advanced Study in Mathematics, with C T Rajagopal (1903-1975) as the first director in its new avatar. With active support from the renowned French mathematician André Weil (1906-98) and the astrophysicist S Chandrasekhar (see later section) and other leading scientists, the institute established itself as a centre for Mathematics.

Statistics

The origin of the Statistics department can be traced to 1930 when a lectureship in Statistics was created in the Department of Economics. Later, in 1941, the new Department of Statistics was instituted.

Zoology

The Department of Zoology, started in 1927, is one of the oldest science departments in the Madras University. Sir K Ramunni Menon (1872-1949), who was
made the Honorary Director, was followed by Professor R Gopala Iyer as Director in 1929 when the former was appointed Vice-Chancellor (1927-34) of the university. The research focus of the department has been in Marine Biology. In particular, substantial contributions were made in the following areas: Biology of coastal marine organisms, Productivity of the sea, through planktonic studies which produced the one and only ‘planktontic calendar’ for the Madras coast, Physiology and pathology including parasites of micro organisms, Ecology of the coastal environment with special reference to reproduction and pathology of marine and brackish water organisms, Biology of marine bio-fouling organisms. The department functioned from the Chepauk Campus till it was moved to the Life Science Building in the Guindy Campus in 1986.

**Botany**

The Department of Botany was established in 1930 with Professor T. Ekambaram as its first director. During his short period of office three theses and a few publications appeared. It was only in 1933 did the University establish a chair in Botany, to which Professor M O P Iyengar was appointed with the designation of Director of the University Botany Laboratory. Professor Iyengar occupied the chair until 1944. During this period, Professor Iyengar and his laboratory investigated fresh water, estuarine and marine algae and their morphology, cytology and life-histories, contributing substantially to our knowledge of tropical algae. In 1944, there was a reorientation of algology to mycology and plant pathology with the appointment of Professor T S Sadasivan (1913-2001) as Director. From then on mycology and plant pathology received intensive and critical attention and a large number of problems in these areas were addressed. The department became one of the leading research centres for Botany in the country. The department, till 1950, had a staff of only one professor and one research assistant. In 1950 one lectureship and in 1953 one readership were created; in 1960, one more readership and two additional lectureships were created.

In 1964, the University Grants Commission named the Botany department as a Centre for Advanced Studies (CAS) especially in the fields of Mycology and Plant Pathology. By then nearly 450 original research papers had been published from the department and over 50 students had taken Ph D degrees.

**Biochemistry**

The Biochemistry department was founded in 1933 with Dr M Damodaran as its first Director. In the early days research focussed on proteins, peptides and proteolytic enzymes. Dr Damodaran was the first to isolate a new globulin (anacardin) from cashew nut, a novel urease from watermelon superior to that from java bean for the estimation of urea in biological fluids, and other chemicals from common vegetable sources. Under Professor P S Sharma, who succeeded Dr Damodaran in 1952, researches on water-soluble vitamins and biochemical investigations using radioisotopes gained emphasis. Significant contributions resulted from his studies on nicotinic acid and its interrelationship with tryptophan, the influence of B-Vitamins on Nitrogen metabolism, and the nutritive value of reconstituted milk. He established the utility of the antimalarial substance paludrine as a preservative for neera (sweet palm juice) and for increasing the yield of palm gur and sugar from neera; a patent was obtained for this process.

**Other Science Departments**

The Department of Physics was established in 1952 with Dr G N Ramachandran (see later section) as professor and head, but later it split into the Department of Crystallography and Biophysics and the Department of Theoretical Physics. In 1969, the Department of Nuclear Physics was set up. The Departments of Organic
Chemistry, Physical Chemistry, Analytical Chemistry and Inorganic Chemistry were started in 1950, 1952, 1960 and 1976 respectively.

Fragmentation of departments has been one of the banes of Madras University. Department of Physics had already earned a good name because of the discoveries made by G N Ramachandran and his collaborators. When new faculty with other specialisation joined the department, newer departments such as the Department of Theoretical Physics and Department of Nuclear Physics were created and the original department was renamed as the Department of Biophysics and Crystallography. Similarly the Chemistry department was fragmented into more than half-a-dozen departments - Organic, Inorganic, Physical and suchlike. Together, the three Physics departments could have formed a strong School and similarly the six Chemistry departments. Although the idea of such schools was tried, it never worked! This was a pity.

A noteworthy anomaly of the Madras University was that most of the Research Departments did not offer post-graduate teaching (that is M A or M Sc teaching) for a long time during their existence. That was left to the colleges. Only in 1976 was this anomalous situation rectified by Vice-Chancellor Malcolm Adiseshiah (1910-94) who introduced post-graduate teaching in the university departments. However even then the bulk of post-graduate teaching remained with the colleges.

Kothari Commission

A Higher Education Commission was appointed by the Government of India in 1964 with Daulat Singh Kothari (1906-93), a distinguished physicist as its chairman. The Commission recommended the creation of 9 Centres of Advanced Study of which Tamil Nadu bagged 5. Madras University had the unique distinction of getting 4 centres: Botany (with T S Sadasivan as director), Mathematics (Ramanujan Institute, with T S Bhanumurthy (b.1925) as Director), Physics (with G N Ramachandran as director) and Philosophy (with T M P Mahadevan (1911-83) as director). The other centre in Tamil Nadu was for Marine Microbiology in Porto Nuovo under Annamalai University. The other 4 were Chemistry (Director: T R Seshadri (1900-75)) at Bombay University, Botany (Director: P Maheshwari (1904-66), and Physics (Director: D S Kothari) at Delhi University and Physics at Calcutta University.

Universities born out of Madras University

Madras University was catering to the Madras Presidency as well as to the neighbouring princely states of Mysore and Travancore-Cochin. The increasing demand for higher education, rendered its operations over such a wide geographical area with a large population more and more difficult. In such a context it was natural that other institutions were created to take over some of the colleges affiliated to the University of Madras.

Mysore University

The first of these was the University of Mysore formed in June 1916, the first university to be established by a princely state: the Maharaja Krishnaraja Wodeyar (1884-1940) was living up to his reputation as one of the few enlightened rulers in the subcontinent. He had the advantage of excellent advice from the educationist C R Reddy (1880-1951); and his Dewan M Visvesvarayya (1860-1962) who as an exceptional administrator gave shape to the Maharaja's vision. Maharaja's College in Mysore (established in 1833) and Central College in Bangalore (established in 1858) formed the nucleus of Mysore University which went on to affiliate all colleges in the princely state which had an area of nearly 30,000 square miles and a population of over six million.

There was only one university created through indigenous (Indian)
initiative prior to the founding of Mysore University: the Banaras Hindu University which came into existence in April of the same year. Krishnaraja Wodeyar was the first chancellor of that university as well as of Mysore University.

Andhra University

The provincial government in Madras formed a second university in the province in 1925 – Andhra University in Waltair (now Vishakapatnam). The institution owes its creation to the efforts of the same C R Reddy whose role was crucial in the founding of the University of Mysore. Reddy was the first Vice-Chancellor of the university and Sarvepalli Radhakrishnan (1888-1975), who later became president of the country (1962-67) succeeded him. The university began by taking over as affiliates the colleges in the Madras Presidency located in the present state of Andhra Pradesh.

Kerala University

The next university to appear on the scene to take over some of the responsibilities of the University of Madras was the University of Travancore; and that was in 1937. (Earlier in 1929 another university – the Annamalai University – had been founded, but it was, unlike the Madras University, a unitary teaching and residential university, not an affiliating institution. We trace its history below in a later section.

The University of Travancore which eventually became the University of Kerala was established at the state capital Trivandrum (now Thiruvananthapuram) in 1937 by a promulgation of the Maharaja of Travancore, Sri Chithira Thirunal Balarama Varma (1912-91) who was also the first chancellor of the university. Sir C P Ramaswamy Iyer (1879-1976), the then Dewan of the State (1936-47), was the first Vice-Chancellor. It was the sixteenth University to be set up in India and ten colleges within the State of Travancore which were affiliated to the Madras University became the affiliated colleges of the University of Travancore. Of these, Maharaja's College, Trivandrum was the most important one; the outstanding mathematician S S Pillai (see later section below) and the agricultural scientist of international renown, M S Swaminathan (b.1925), were students of this college.

Annamalai University

Annamalai University was the creation of a visionary philanthropist, Annamalai Chettiar (see later section below) who had built a big fortune as a businessman and entrepreneur.

Since the publication of the Report of the Sadler Commission (Calcutta University Commission; Sir Michael Ernest Sadler (1861-1943), a British educationist was the chair), which was appointed by the Government of India in 1917 to conduct an investigation into the problems connected with the University of Calcutta, and to make recommendations concerning them, educational opinion in the country was in favour of unitary residential universities since they could contribute more effectively towards higher academic work – both in teaching and research. Early in 1928 the committee appointed by the Government of Madras to examine the need for establishing a new university in the Tamil districts wrote in their report that it was desirable to establish many unitary universities, but the government could assure the financial resources even for one. Even while these words were being written, Annamalai Chettiar was in consultation with the government, regarding his scheme for the creation of a University at Chidambaram. He offered to hand over the three collegiate institutions that he had founded in Chidambaram to the proposed university along with a princely sum. Recognizing the unique nature of this benefaction, the government came to the conclusion that they must not miss this opportunity of encouraging private
effort in the cause of public instruction and establishing a new university of the desired unitary type. It decided to grant a matching sum and also a recurring sum to the new university. A bill was passed in the Legislative Assembly and Annamalai University came into being on 1 January 1929.

The first Vice-Chancellor was Dewan Bahadur Sir Samuel Ebenezer Runganadhan (b. 1877) while the Right Honourable V S Srinivasa Sastri (1869-1946) served as the next one from 1935 to 1940. Although Tamil and Music were given pride of place in Annamalai University, Mathematics and Science were not ignored. The mathematician S S Pillai (see later section below), did his outstanding work in Number Theory at Annamalai University. The Marine Biology Centre of the Annamalai University at Porto Nuovo is known for many important discoveries in the field.

The establishment of Annamalai University was a landmark in the history of educational and scientific institutions in South India. Annamalai University has always had a special place in the Tamil mind. However it must be admitted that unfortunately the University has not lived up to its initial expectation and reputation as a unique institution. In the last decades, due to various sociological and political factors, Annamalai University has also been functioning like all other state-supported universities in the country. Perhaps another Annamalai Chettiar is needed to bring it back to its original glory.

Beyond the Subaltern Horizon: The trail-blazers

The main purpose of the colonial administration in setting up institutions for higher education was to ensure a steady supply of subaltern human resources. And these institutions, among them the University of Madras, served that purpose admirably. However there was an unanticipated by-product – the emergence of outstanding men of science, men equal to the best in the Western world in scientific achievement. The main reason for this was that brilliant young Indian minds once exposed to Western ideas, to science in particular, could not be contained within the limited agenda envisaged by the colonial rulers. Secondly, the academics from Britain who came to India did not often share the attitude of the architects of their government's policies and in any case did not strain themselves to implement them.

The University of Madras counts five outstanding scientists of the highest calibre among its alumni: the mathematician Srinivasa Ramanujan and the physicists C V Raman, S Chandrasekhar, K S Krishnan and G N Ramachandran. Products of the university they were, but except in the case of the first and last named, the university played a somewhat limited role in fostering their great talents but was nevertheless crucial. It was the university that was responsible for these people getting any exposure at all to advanced science: all the physicists underwent undergraduate courses at affiliated colleges and had access to books in their college libraries. Ramanujan too had indirect access to some books, available at a college library through friends. Raman had teachers who recognised his talents and encouraged him. Ramanujan and Chandrasekhar had the benefit of contact with distinguished visitors thanks to the university.

Apart from these stars, whose careers we briefly trace below, there were quite a few mathematicians whose achievements were also well beyond the subaltern horizon; and of some of these we will talk about in a later section.

Srinivasa Ramanujan (1887-1920)

Srinivasa Ramanujan was of course the greatest figure in science to emerge from India in the twentieth century. He was born in Erode, a small town in the Madras Presidency and grew up in Kumbakonam, another small town also in Madras Presidency. Ramanujan's father was an indigent accountant and the family eked
out a hand-to-mouth existence. His mother was the dominant figure in the family and was a source of strength for him in his childhood and early youth. In later years she was a cause for much distress to Ramanujan and his wife though.

Ramanujan showed much promise in school winning scholarships through outstanding performance in all subjects but his abilities at mathematics had attracted notice as being out of the ordinary. After school he joined Government College, Kumbakonam to pursue higher studies, but this foray into university education turned out disastrous; he could not pass the F A examination despite repeated attempts, thanks to his (by now) great obsession with mathematics which prevented his paying the necessary attention to other subjects. He was on the other hand working away intensely at mathematical investigations. Despite the failure at college Ramanujan continued to work away at mathematics for the next five years - his needs were few and he was supported by the family although with difficulty. But in 1909 (at the age of 22) he married and needed employment. With his poor track record at college, he was obliged to seek help from men acquainted with mathematics who he hoped could appreciate his mathematical abilities despite that record. He was successful in this quest: Ramachandra Rao\textsuperscript{53} (b. 1871), an amateur mathematics enthusiast, extended financial support to him for a year and more which enabled him to pursue his interests in Madras.

Ramanujan, unwilling to be a burden for long on his benefactor, secured a clerkship at the Madras Port Trust with his help. Ramachandra Rao however conveyed to the Port Trust authorities his high opinion of Ramanujan's talents and urged them to encourage the young man in his pursuit of mathematics. Ramachandra Rao's enthusiasm for Ramanujan found a remarkable resonance in Sir Francis Spring\textsuperscript{54}, the Chairman of the Port Trust who let Ramanujan pursue his mathematical interests which had little to do with his formal duties at the Port Trust. Narayana Iyer\textsuperscript{55} (1874-1937), a senior employee of the Port Trust who evinced a keen interest in mathematics, became a close friend with whom Ramanujan could share the joy of his discoveries.

Sir Francis Spring took the initiative to consult Gilbert Walker\textsuperscript{56} (1868-1958), then Director General of Observatories in India when the latter was on an official visit to Madras, about Ramanujan. Walker who was trained in mathematics in Cambridge wrote emphatically to the university authorities recommending that they provide Ramanujan with a scholarship to enable him to pursue his researches in mathematics. The university accepted the recommendation and in 1913 Ramanujan started work as a Research Scholar at the university. During the time he worked at the Port Trust Ramanujan wrote to the famous Cambridge mathematician G H Hardy\textsuperscript{57} (1877-1947) seeking his advice and help for publishing the research work he had done. Hardy was greatly impressed with what Ramanujan had to offer and promptly set to work to get him to Cambridge. In early 1914, E H Neville\textsuperscript{58} (1889-1961), a geometer and a Fellow of Trinity in Cambridge arrived in Madras to deliver some lectures under the auspices of the university. Hardy made him his emissary to Ramanujan as well as to the university to persuade the latter to arrange for Ramanujan to visit Cambridge for collaborative research. Neville succeeded in his mission.

Ramanujan arrived in Cambridge in April 1914 and the next five years saw him produce some spectacular mathematics, a good part of it in collaboration with Hardy. England bestowed on him the highest academic honours: Fellowship of Trinity College at Cambridge and Fellowship of the Royal Society. The English sojourn however ended not so happily as Ramanujan fell seriously ill and returned to Madras to recoup his health in the warmer climate. Unfortunately, his illness grew worse and he breathed his last on 26 April 1920: he was not yet 33 but even during the long period of illness Ramanujan continued to produce research of high calibre.

Much of Ramanujan's mathematical work was in Number Theory. Ramanujan's work on the so called partition functions is among the most exciting in the area. He developed what is known as the 'Circle Method' partly in collaboration with Hardy; this technique has over the years proved one of the most successful tools for solving a host of problems in Number Theory. One of his preoccupations
was with the 'tau' function which did not attract much attention from his contemporaries. As it turned out the subject was to occupy centre stage in mathematics in later decades; and his insights had led him to a conjecture about it whose proof in 1974 by a leading mathematician P Deligne\(^59\) (b.1944) was one of the exciting mathematical events of the century. Ramanujan was exceptionally gifted at formal algebraic manipulations and the many formulae he wrote down connecting apparently unrelated expressions (often without proof) continue to challenge many leading minds.

The Ramanujan story, though it ends as a tragedy reads like a fairy tale with no witches. Indeed most of the dramatis personae, English as well as Indian come out as wonderful human beings. The story redounds much to the credit of the University. It must be noted that the University had also an important even if indirect positive role in Ramanujan's career. Ramanujan's first source of inspiration was a rather mediocre mathematics book — Carr's Synopsis\(^60\); and he could access this book only because it covered material that was relevant to the courses offered at the university and so was available in libraries. The Indians who helped him were all mathematics graduates at the university and that exposure was what enabled them to appreciate Ramanujan's talents. As we point out later the university was responsible for creating a milieu with an appreciation of contemporary developments in mathematics and science already in the first decade of the century.

\textbf{C V Raman}\(^61\) (1888-1970)

Raman's ancestors were agriculturists owning land in Tanjore District. Raman was born on 7 November 1888 in his maternal grandfather's house in Tiruvanaikaval. The name given to him was Venkataraman and according to the usual practice in South India his full official name would have been Chandrasekara Venkatraman, 'Chandrasekara' being his father's given name. He however at some point split up his given name as Venkata Raman and abbreviated the full name to C V Raman. Raman's father Chandrasekara Iyer (1866-1910) did Intermediate in the SPG College, Trichy and joined a B A course in Madras Christian College but did not complete it. He worked as a school teacher for many years, went back to SPG College, obtained B A in Physics and became a lecturer in the same college. When Raman was 4 years old, his father moved to Vizag (Visakhapatnam) to take up a lecturer's job in the Mrs A V Narasimha Rao College. He taught physics, mathematics and physical geography.

At the incredibly young age of 11, Raman passed the matriculation examination, standing first and joined AVN College, Vizag for an Intermediate course. In 1902 he was off to Madras with a scholarship to study for the B A degree at Presidency College. Apparently they had never seen any one so young before in the college. He was 14!

\textbf{Raman at the Presidency College}

Presidency College was the premier College in the South, to which all ambitious young men aspired to go. In college, besides physics, Raman developed a great liking for English, stimulated by the English classes conducted by Professors Bilderbeck and Elliot. We quoted his eloquent tribute to his English teachers in the section on Presidency College. Raman passed the B A examination in 1904 obtaining the first rank in the University and winning gold medals in English and Physics. His teachers suggested that he should go to England for further studies. But the Civil Surgeon of Madras ruled it out saying that the young and frail Raman would not be able to stand up to the rigours of the English climate. Raman later said of this Civil Surgeon, 'I shall ever be grateful to this man'. Ten years later Srinivasa Ramanujan went to England and the disastrous effect of the English climate on his health led to his premature death. Unable to go abroad, Raman enrolled in the M A (Physics) class in the Presidency College. The Professor of Physics was R Llwellyn Jones who recognized Raman's flair for physics and gave him complete freedom to pursue his interests. During the whole two years' of M A, Raman attended only one lecture, that too by Jones himself!
Raman made good use of the academic freedom given to him by the kindly Jones, tinkering around the laboratory and trying out various things. There was not much available by way of scientific equipment except the usual assortment of lenses, prisms, gratings, tuning forks, sonometer and suchlike needed for class work. But, for Raman, that was ample! Guided by irrepressible curiosity, he posed himself many questions, and to settle them he performed many experiments. Often the questions were of a type the answers to which were not found in the published literature. Instinctively he had discovered the essence of research, and it was this spirit of enquiry that was to constantly drive him to do experiments throughout his life.

Raman commenced his acoustical researches at the age of 16 as a student at the Presidency College. Raman's father Chandrasekara Iyer (who was a teacher of Physics and Mathematics) had a good collection of books on varied subjects and was also a proficient violinist. These must have influenced Raman as a child (he also became a competent violin player). Before he was 13, he read Hermann von Helmholtz's (1821-94) Popular Lectures on Scientific Subjects from his father's library. Raman said 'It was my good fortune, while a student at College to have possessed a copy of an English translation of his work The Sensations of Tone. As is well-known, this is one of Helmholtz's masterpieces... I discovered the book myself and read it with the keenest interest and attention. It can be said without exaggeration that it profoundly influenced my intellectual outlook. For the first time I understood from its perusal what scientific research really meant, and how it should be undertaken'.

Here is probably the answer to the enigma of why a 16-year old boy started doing research at a place where there was no tradition of original research. No wonder too that the earliest research Raman started at the Presidency College in 1905 was connected to a field (acoustics) pioneered by Helmholtz. But Raman's first acoustical paper was published only in 1909 and it was on a musical instrument called 'Ektara' (used by the poor itinerant singers of India) which had distinctive acoustical properties. Curiously, this paper of Raman was published in the Journal of Indian Mathematical Club (which became Indian Mathematical Society (see later section). There was no journal for Physics in India at that time! Another historical curiosity is that Raman was a Currency Officer in Rangoon when he sent this paper for publication.

As a student (1902-1906) Raman mastered Lord Rayleigh's (1842-1919) two-volume work on The Theory of Sound which laid the foundation for all his subsequent work in acoustics. The Presidency College in those days did not have scientific journals, but the Connemara Library did. Raman as a student of 15 regularly bicycled to this library in Egmore to read the latest scientific papers of Rayleigh and others. With the apparatus that he could find in the Presidency College and the freedom that Professor Jones gave, Raman performed original experiments. One such experiment was on asymmetrical diffraction. Raman wrote the results in the form of a paper and gave it to Professor Jones for comments. Since Jones did not respond even after several months, Raman sent the paper on his own to the Philosophical Magazine in London and the paper was published in November 1906. Raman was the sole author and there was no acknowledgment. He was barely 18 and not yet out of college. His achievement was all the more significant because Presidency College was essentially a teaching college with no tradition whatsoever of research. Indeed his was the first ever research paper to come out of that institution.

There were many questions on asymmetrical diffraction not answered in this first paper to which he returned in his later years in Calcutta. Incidentally, almost immediately following Raman's paper there is one by the famous R W Wood (1868-1955) of Johns Hopkins University and years later Wood was to send a cable to Nature hailing the discovery of the Raman Effect. The paper on asymmetrical diffraction was no flash in the pan, and there was yet another one in the Philosophical Magazine, also reporting his work done in Presidency College. This second paper, entitled 'The curvature method of determining the surface tension of liquids', was inspired by some remarks on capillarity made by Lord
Kelvin (1824-1907) in the book *Popular Lectures and Addresses*. Once again it is a single-author paper, and once again there are no acknowledgments. If his first paper had a distinguished companion, so did his second one, this time it was a paper by the great Lord Rayleigh, the subject being the sensitiveness of the ear to pitch. Interestingly, Raman himself was to enter this general area later. Raman's papers attracted Lord Rayleigh's attention. It is said that Lord Rayleigh addressed Raman as Professor. No wonder, since he would not have known Raman was but a mere student still in his teens.

It is clear that although Calcutta, The Association for the Cultivation of Science founded by Mahendralal Sircar (1833-1904), Sir Taraknath Palit (1831-1914) and Sir Asutosh Mookerji (1864-1924) deserve credit for making the subsequent illustrious life and achievements of Raman possible, the original Raman was made in the Presidency College, Madras. After his famous discovery of Raman Effect in Calcutta in 1928, Raman returned to the South. His eventful years in the Indian Institute of Science, Bangalore and his establishment of the Raman Research Institute are an interesting part of the history of science in South India. But that is another story. Here we shall only mention that he also founded the Indian Academy of Sciences and the Journal *Current Science* in 1934 both of which play dominant roles today.

**Beyond the Subaltern Horizon: The worthy successors**

**Subrahmanyan Chandrasekhar** (1910-1995)

Chandrasekhar was born in Lahore on 19 October 1910 as the first son of C S Ayyar and Sitalakshmi. When Chandra (as he was to his friends) was six, the family moved to Lucknow. Two years later in 1918, C S Ayyar (1885-1960) became Deputy Accountant General in Madras and he established the family in Madras. Although he was transferred to various places throughout his career, his family stayed put at Madras. Chandra studied at home along with his brothers and sisters. He had two elder sisters, four younger sisters and three younger brothers. His home education was quite disciplined. Once Chandra's father noticed his exceptional brilliance (for which the family had a precedent – Chandra's uncle C V Raman), he hired private tutors to teach Chandra. Not until he was eleven, did he go to a regular school, where he was accepted straightaway into the third form of high school (which is equivalent to the eighth standard of the present-day school system). The Hindu School in Triplicane where he joined was considered the best school in Madras.

Education at home had opened his mind to a free play of its own without being cramped by a load of educational lumber. All this changed in the school and Chandra did not like it. But once he discovered that the fourth form curriculum included algebra and geometry, he got excited and began studying these subjects on his own in the summer vacation itself. He completed the two books on geometry by Pierpoint before the fourth form class started. He already knew all the geometry and algebra they were going to teach, and in fact more – permutations and combinations, solving cubic equations and so on. Similarly in his next three summer vacations, he started studying conic sections, coordinate geometry, calculus and differential equations. With this kind of drive and motivation, it is no wonder that Chandra did extremely well in the high school. More importantly, it is appropriate to remember that Chandra has been regarded by many as the greatest mathematical physicist after Lord Rayleigh. One can see that the seed for that growth was sown during his schooldays.

**Chandra at Presidency College**

Chandra's first two years (1925-27) in the Presidency College, Madras proceeded smoothly. His private studies in mathematics put him far ahead of his fellow students in the intermediate class and he invariably received the highest grade in the class. In college he studied physics, chemistry, mathematics, English and Sanskrit. He found himself drawn to physics rather than chemistry and he also
had an innate enthusiasm for English (same as his uncle Raman!). After completing his intermediate with distinction in mathematics, physics and chemistry, he wanted to join B A (Honours) in Mathematics. In April 1920, the newspapers announced the death of Ramanujan and Chandra's mother had talked to him about the mathematical genius. Chandra was only ten at that time. Two years later Chandra heard the name again, this time from his uncle Raman during one of his visits to Madras, in a conversation with Chandra's father. Later Chandra learnt more about Ramanujan and came under the spell of mathematics. He therefore wanted to pursue mathematics.

But his father had different ideas. He wanted Chandra to do the B A (Honours) course in physics and go to England for the ICS examination. Chandra had no intention whatsoever of doing ICS and entering government service. But in a very clever move, he agreed to do B A (Honours) in Physics, since Physics also was near his heart and the ICS examination was not an immediate concern.

Once Chandra made the decision to join Physics Honours, during the summer of 1927 he read Arnold Sommerfeld's (1868-1951) book Atomic Structure and Spectral Lines, a classic treatise on what we now call the 'old quantum theory' of the atom. It was certainly too advanced and difficult for one who had only completed Intermediate, but Chandra was able to work his way through it. Thus essentially on his own, he gained a formidable background in both physics and mathematics.

His three years at Presidency College (1927-30) were eventful years. Arnold Sommerfeld visited India in 1928 and lectured at the Presidency College. Sommerfeld was a great theoretical physicist from Germany and the list of physicists who studied under him reads like a 'Who is Who' in Theoretical Physics: Peter Debye (1884-1966), Paul Ewald (1888-1985), Gregor Wentzel (1898-1978), Wolfgang Pauli (1900-58), Werner Heisenberg (1901-76), Otto Laporte (1902-71), Albrecht Unsold (1905-95), Walter Heitler (1904-81), Hans Bethe (1906-2005), Rudolph Peierls (1907-95) and Herbert Fröhlich (1905-91). Einstein is reported to have remarked to him: 'At the stamp of your foot, talented young theorists seem to spring forth from the ground'. Chandra says, 'From a purely scientific point of view, the most crucial incident was my meeting with Sommerfeld when he visited Madras in 1928' and he continues: 'I went to visit him in the hotel and told him I was interested in physics and would like to talk to him. He asked me to see him the following day, and so I went. He asked me how much I had studied. I told him I had read his Atomic Structure and Spectral Lines, an English translation. He promptly told me that the whole of physics had been transformed after the book had been written and referred to the discovery of wave mechanics by Schrodinger, and the new developments due to Heisenberg, Dirac, Pauli and others. I must have appeared somewhat crestfallen. So he asked me, what else did I know? I told him I had studied some statistical mechanics. He said, "Well, there have been changes in statistical mechanics too", and he gave me the galley proofs of his paper on the electron theory of metals, which had not yet been published'.

Chandra was not discouraged by the encounter, but launched into a serious study of the new developments that had stunned Europe but had not yet made their way into India. Sommerfeld had applied the quantum statistics discovered by Fermi and Dirac to the electrons in a metal. Fowler showed that the same electron degeneracy coming from Fermi-Dirac statistics stabilizes a burnt-out star and Chandra's discovery of the limiting mass for such stars called white dwarfs was based on relativistic electron degeneracy. This discovery he made after he reached Cambridge and it is this discovery that won him Nobel Prize much later, but the thinking had started while he was at Madras.

Chandra's first three papers were written while he was still a student of Presidency College repeating the performance of his uncle two decades earlier. These were,

Chandra left for England in 1930, but before that some important events that left their influence on him must be described. The year 1928 was an exciting year for Indian Science. On February 28 of that year, C V Raman along with K S Krishnan, made a fundamental discovery in the molecular scattering of light, later known as 'Raman effect'. This discovery was made in the Indian Association for the Cultivation of Science in Calcutta. Chandra heard his uncle Raman describe this effect, when the latter visited Chandra's home in Madras, on his way to Bangalore to announce the discovery. Later, Chandra went to Calcutta to spend the summer and had an exciting time with Raman, Krishnan and other scientists.

Werner Heisenberg (1901-1976), the discoverer of Quantum Mechanics, visited Madras in October 1929 and as the secretary of the Students Science Association Chandra was in charge of Heisenberg's visit to Presidency College. Further, under the direction of Krishnan who was also in Madras at that time, Chandra had the responsibility of showing Heisenberg around. Chandra spent a whole day taking him around the famous temples at Kanchipuram and Mahabalipuram and later during the night driving along the Madras seashore. It was an exhilarating experience for an undergraduate student to be in the exclusive company of such a famous scientist. Chandra discussed his own papers with Heisenberg and writes 'In one day by merely talking to him, I could learn a world of physics'.

Other important events were that the Indian Science Congress was held in Madras and Allahabad in January of 1929 and 1930 respectively. In the Madras meeting Chandra presented his paper and H Parameswaran (1897-1953) (one of Chandra's Physics Professors, who was well-known as the inventor of Waran's pump) stood up and pointed out that the author of the paper was just a student in the second year of B A Honours course and he had written the paper without any guidance or advice from anyone. Of course that elicited a thunderous applause. At Allahabad, Chandra was the guest of astrophysicist Meghnad Saha (1893-1956) who was already famous for his theory of thermal ionization. Chandra's future work would be in astrophysics, but he was already treated as an equal by Saha.

A lot more occurred outside science: Chandra's encounter with an English couple who did not want to travel with him in the same railway compartment, his joining the crowds with other students to welcome Jawaharlal Nehru (1889-1964) (later the first Prime Minister of India) to Madras and attending his speech on the seashore, for which he was reprimanded by the Principal of the college P F Fyson the next day, and his intentionally doing poorly in the history paper (in the high school earlier) to protest the fact that too much British history was required in the syllabus and very little Indian history.

The kind of academic record that Chandra created at Presidency College at such a young age made the Madras State Government act. They offered a Government of India scholarship to him to pursue his research in England. His professors in the Presidency College, especially Parameswaran and Principal Fyson played a major role in this development. Chandra left for Cambridge, England in July 1930.

K S Krishnan (1898-1961)

Kariamanikkam Srinivasa Krishnan was born on 4 December 1898 in the village Villupunoor in the Ramanathapuram District, the son of a school teacher. After schooling in the towns of Watrap and Srivilliputtur, he did Intermediate in the American College, Madurai and B A in the Madras Christian College (MCC).
At MCC, he became a favourite of Reverend Alexander Moffat, Professor of Physical Science, and a great scholar. Moffat saw in Krishnan a rare flair for science and he did not want to lose him. He prevailed upon the college authorities to offer him an appointment. In October 1918, Krishnan joined MCC as a temporary Demonstrator in Chemistry.

Although Krishnan enjoyed his work in the Chemistry Laboratory of MCC and especially the ‘tiffin'-hour discussion sessions with the students, his inner desire was to take up a career in research. Moffat knew that MCC will not be able to offer adequate research opportunities for the talented Krishnan. By then the fame of C V Raman's Calcutta School of Physics had spread and bright and young students, especially from the South, were being attracted to it. Krishnan decided to try for a seat in the M Sc Physics programme of the University of Calcutta where Raman lectured regularly. He sent in an application for the next academic session to begin in July 1920, although he had not yet fully decided whether to really take the plunge and leave the familiar South to travel far from home to an entirely new environment.

Now comes a connection with the Kodaikanal Observatory which already appeared in this narrative. Moffat learnt that the Solar Physics Observatory in Kodaikanal was in urgent need of a suitable person to fill in a vacancy in the Second Assistant's post. He urged Krishnan to apply for it and strongly recommended him to the Director, John Evershed (1864-1956). This was in February 1920. The vacancy was caused by the death of a G Nagaraja Iyer in 1918 due to influenza which killed five million in India alone. He was a very good astronomer who had already made important contribution on sunspots. His loss was severely felt. Both Evershed and the Director-General of Observatories Gilbert T Walker decided to find the best person to replace this loss.

Krishnan was appointed to the post and he was thrilled. This seemed to be the opportunity he was waiting for. In his school days he often dreamt that he would become an engineer some day, but later during the undergraduate years, his attention had turned mainly to physics and mathematics. Kodaikanal was closer to home and Evershed's reputation as a scientist was enviable. The Observatory he headed was known to be one of the best in the world. Krishnan decided he would go to Kodaikanal.

But unexpected developments took place that changed the course of Krishnan. In the Madras Meteorological Office which was part of the Madras Observatory which was directly under the control of the Director, Kodaikanal and Madras Observatories, there was a P R Chidambara Iyer who also nurtured a desire to work under the great Evershed in Kodaikanal. He made a very forceful representation to the authorities for a transfer to Kodaikanal on the basis of his service in the Madras Meteorological Office since 1914. Although Evershed had already issued the letter of appointment to Krishnan, he spoke to Moffat and requested him to convince Krishnan to take up Chidambara Iyer's position in Madras and transferred Iyer to Kodaikanal. Krishnan was not interested in the routine data collecting job at the Meteorological Office and refused it. Soon after, Calcutta University offered the seat he had applied for and the South lost him.

The loss to astronomy was a gain to physics, since Krishnan turned out to be an outstanding physicist. He became a co-discoverer of the Raman Effect and made pioneering contributions to what is now called condensed matter physics. But that is another story.

G N Ramachandran (1922-2001)

After doing B Sc (Honours) in St Joseph College, Trichy, Gopalasamudram Narayana Ramachandran (commonly addressed as GNR) began his journey in science when he joined the Indian Institute of Science, Bangalore in 1942 as a student in the Electrical Engineering Department. He realized very quickly that his interests lay in physics, a subject then overwhelmingly dominated in Bangalore by the
presence of the legendary C V Raman. Raman told the Professor of Electrical Engineering: 'I am admitting Ramachandran into my department as he is a bit too bright to be in yours'. At Bangalore he first submitted a thesis entitled 'Optics of Heterogeneous Media' for an M Sc degree of the Madras University and later a doctoral thesis in 1947, which contained some of the earliest applications of X-ray diffraction to the study of crystal perfection. He spent two years in Cambridge, obtained a Ph D degree working with W A Wooster (d. 1984) and returned to Bangalore in 1949 to work in the X-ray diffraction laboratory that he was instrumental in building as a student. He did not stay long.

Madras University beckoned Ramachandran with a professorship and the responsibility to head a new Department of Physics. An enlightened Vice-Chancellor, A Lakshmanaswamy Mudaliar actually wanted C V Raman to come to Madras and build the Physics Department, but the latter instead recommended G N Ramachandran for the position and Ramachandran moved to Madras when he was just 30, to begin an extraordinary burst of scientific activity. At Madras he flourished under the benign and supportive influence of A L Mudaliar; a relationship reminiscent of that between Asutosh Mookerji and C V Raman in Calcutta. J D Bernal (1901-71) visited Madras in 1952 and a casual conversation revealed that no satisfactory model for the structure of collagen existed. The Central Leather Research Institute was next door to G N R's Department in the Alagappa Chettiar College of Technology. Through them he soon procured collagen samples from a kangaroo tail tendon. Ably assisted by his Post-doctoral Fellow Gopinath Kartha (1927-84), he soon had X-ray diffraction photographs of the collagen fibres. The triple helix emerged in two papers published in Nature in 1954 and 1955, introducing the coiled coil structure, a fundamental advance in the understanding of polypeptides.

But, in a sharp critique, Francis Crick (1916-2004), fresh from his DNA success, together with Alexander Rich (b.1925) argued that the Madras structure was steriochemically unsatisfactory. Out of the collagen controversy was to emerge what is undoubtedly GNR's finest contribution to structural biology. GNR together with his colleagues C Ramakrishnan (b.1933) and V Sasisekharan (b.1939) laid the foundations for the conformational analysis of polypeptide chains. Their seminal paper published in the Journal of Molecular Biology in 1963, circumspectly titled 'Stereochemistry of polypeptide chain configurations', introduced the two-dimensional map which eventually came to be known as the famous Ramachandran map. This also forms the cornerstone for the description of protein folding. The simple concept of reducing the structure space of protein chains to two dimensions with dihedral (torsional) angles as the two variables had a profound impact on stereochemistry and structural biology.

G N R continued to shine with many outstanding contributions and his Department of Biophysics and Crystallography at the University of Madras became a Mecca for the new science of Molecular biophysics. G N R's work brought an unprecedented level of recognition to Madras University. But, unfortunately this glory was to end unceremoniously. After the departure of the famous Lakshmanaswamy Mudaliar from the helm of affairs, the academic atmosphere of the university deteriorated. The norms of the succeeding administration did not recognize merit or achievement as a desirable qualification. Other considerations (to be commented upon in a later section) began to assume a dominant role. G N R was almost driven out of Madras University. He returned to Bangalore and in 1971 founded the Molecular Biophysics Unit at the Indian Institute of Science which developed into a major centre for the subject. He passed away in Madras in 2001.

G N R's two decades at Madras University was a glorious chapter in the history of the University. It clearly showed that the highest levels of research could be practised within our University system.

The Mathematicians from the South
Raman and Ramanujan had blazed new trails and put India emphatically on the map of world science but their Indian milieu was by no means a scientific wilderness: lesser intellects were imbibing science at advanced levels and showed considerable enthusiasm for it. There was an awareness of contemporary developments among the academics and graduates of the university. And in one discipline – mathematics – the university produced a number of mathematicians who performed at a superior level (even if they could not match the spectacular record of Raman or Ramanujan) resulting in the emergence of what may be well called a school. The emergence of this school was preceded by the founding of The Indian Mathematical Society (IMS) – the first scientific society in the country. IMS played an important role in the promotion of mathematics in the country and we digress to say a few words about it.

The Indian Mathematical Society83

V Ramaswamy Iyer (1871-1936), a graduate from Presidency College took the initiative to form a mathematical society called the Indian Mathematics Club in 1907 which took the name Indian Mathematical Society in 1909. The ‘Club’ had 20 founding members and some 12 of them were teachers in colleges affiliated to the university. Among the rest too there were graduates of the Madras University though engaged in other professions (Ramaswamy Iyer himself was a Deputy Collector in the provincial administration). Dewan Bahadur Ramachandra Rao, Ramanujan’s benefactor was among the founders and served as the first Secretary. He also served as President during 1915-17. Leafing through the early issues of the journal of the IMS one finds quite a few contributions from Madras and Bangalore; one can glean from these that there was among these men considerable interest in advances made not only in Britain but elsewhere in the Western world; and the journal published papers in areas close to Physics. We already noted the fact that in the very first issue of the journal there is a paper by C V Raman which in fact deals with experimental work in physics. Some later issues too carry articles by him. Ramanujan’s first published work appeared in that journal. The Society continued its good work into the early decades after independence.

Ananda Rau (1893-1966)

The principal architect of the ‘mathematics school’ in Madras was Ananda Rau a contemporary of Ramanujan. He was born into relative opulence and after securing the B A in mathematics at the University of Madras took up doctoral studies at Cambridge under the guidance of Hardy. After completing his studies there, he returned to India in 1919 and was appointed Professor of Mathematics at Presidency College; and after Ramanujan’s death in 1920, Ananda Rau was the leader of mathematical research activity in Madras. He was a first rate mathematician, his work in what is known as summability theory earned him international recognition. He went on to guide a number of brilliant students who in their turn became leading mathematical figures with excellent international reputations. All of them cherished their association with their teacher for whom they had great affection and respect. Ananda Rau retired from service soon after independence.

R Vaidyanathaswamy (1894-1960)

In 1926 the university created a Research Department of Mathematics and appointed Dr R Vaidyanathaswamy its Reader and Head. Vaidyanathaswamy held a doctorate from England but his mathematical interests were broad. Apart from Geometry, he also worked in areas like Symbolic Logic, Topology and Lattice Theory which were not Cambridge favourites. He joined forces with Ananda Rau in creating a lively atmosphere for students at the university. His broad interests in mathematics and beyond made him a much admired figure in the academic circles. He served with distinction for more than a decade as the Editor of the Journal of the Indian Mathematical Society. He retired from service in 1952.
S S Pillai (1901-50)

The first student of Ananda Rau to achieve international fame was S S Pillai. It is difficult to script a grimmer tragedy than his biography. He was born in 1901 and lost his mother the very next year. His father died in his last year at school. He managed to pursue higher studies with financial help from a teacher and through scholarships to earn a B A degree from Maharaja's College in Trivandrum. He then moved to Madras as a research scholar at the university working with Ananda Rau. He proved himself to be an outstanding researcher and secured his doctoral degree with ease. His first job was at Annamalai University where he did some epoch making work in Number Theory attacking what is known as Waring's problem. After the stint at Annamalai, he moved to Calcutta University and eventually to Madras. His work earned him in 1950 an invitation to visit the prestigious Institute for Advanced Study in Princeton, USA. But tragedy struck again before he could savour his success: on 31 August 1950, he died in an air crash over Egypt; he was on his way to Princeton, his first trip abroad.

T.Vijayaraghavan (1902-55)

Vijayaraghavan was a student of Ananda Rau in the B A (Honours) course at Presidency College. Even as an undergraduate he embarked on some original research with encouragement from his teacher. He failed in the Honours degree examination; nevertheless thanks to support from Ananda Rao and Hardy to whom he had sent his researches, the university awarded him a scholarship to work with Hardy at Oxford (in 1925) (Hardy had moved there). He returned to India with a doctoral degree from Oxford to work at Annamalai University. Later he moved to Aligarh, then Dacca and again in 1946 to Andhra University. He returned to Madras in 1949 to head the Ramanujan Institute created by Alagappa Chettiar. He died in 1955. Vijayaraghavan was an outstanding Analyst as well as a Number Theorist.

Reverend Father C Racine (1897-1976)

With the arrival of Reverend Fr Racine, a French Jesuit at Loyola College in 1939, mathematics in Madras grew to greater strength. Father Racine studied mathematics in Paris after he was ordained a priest by the Jesuit Order; he had joined the Order after he was demobilised from active service in the first world war. In 1934 on his completing his doctorate, the Jesuit Order sent him to teach at St Joseph's College, Trichinopoly and later transferred him to Loyola College. Trained as he was in Paris which was the leading centre for mathematics, he had an excellent perspective on mathematics and was abreast of the most recent developments. He moved in with ease into the Madras mathematical milieu and became a big influence on generations of students. He was of course a first rate mathematician much respected by Ananda Rau and Vaidyanathaswamy and in turn reciprocated their warm feelings.

S Minakshisundaram (1913-68)

The first signs of Father Racine's impact on the Madras scene is to be seen in the career of Minakshisundaram, one of the most gifted mathematicians of the pre-independence era after Ramanujan. Minakshisundaram had his early education in Madras and took his B A (Honours) degree from Loyola College (before Father Racine arrived there). He then became a Research Scholar at the university and worked with Ananda Rau for a couple of years. He then came under the influence of Racine and his interest drifted into Differential Equations where he did some interesting work that earned him the D Sc degree. After a difficult period without a job he joined Andhra University as a lecturer in 1940. His talents impressed a visiting mathematician from the USA, Marshall Stone who arranged for him to visit the famous Institute for Advanced Study in Princeton
(see Note 84). The 2-year visit facilitated a collaboration with a Swede, A Pleijel (1913-89), in some outstanding work of lasting value in Global Analysis. Just two years before his death in 1968, he moved north to Simla when he was appointed to a professorship at the Institute of Advanced Studies there.

**K Chandrasekharan (1920-)**

Ananda Rau had many worthy students; Komorovolu Chandrasekharan was one among them, but his contribution to Indian mathematics went beyond his own researches. He was an excellent Analyst and also worked in Number Theory, but perhaps his greater achievement was the mathematics school which he built at the Tata Institute of Fundamental Research in Bombay in the early decades after independence. He was very much a product of the University of Madras of the forties and greatly cherished his association with the Madras triumvirate: Ananda Rau, Vaidyanathaswamy and Father Racine. Most of the people who contributed to the making of the Bombay school were products of the Madras colleges with Father Racine playing a big role. In his efforts at building the school in Bombay Chandrasekharan was ably assisted by another contemporary product of the Madras school, K G Ramanathan (1920-92), a student of Father Racine.

**Institution Builders and Educationists**

Most of the higher educational institutions during the colonial period were built by the colonial government or by Christian missions; a few were created in the princely states by the more enlightened among the rulers. The governments involved, and the missions too, of course commanded huge financial resources. There were however a few institutions that came into existence through the munificence and vision of a few individuals. These philanthropists were no doubt very wealthy, but hardly in the same league as the governments or the missions; nevertheless their contribution is significant. This section is devoted to brief accounts of some of the most prominent of these from the South.

**Pachaiyappa Mudaliar (1754-94)**

Pachaiyappa Mudaliar was born in 1754 in Periyapalayam near Kancheepuram. In spite of losing his father when he was five years old, he learnt business and English through the generosity of a family friend whose help was sought by his mother. He was appointed as a Dubash (interpreter) in the service of a British merchant. Soon he rose very high in business and political connection with the East India Company and then the Raja of Tanjore. He died in 1794 when he was only 40 years old. Before his death he had drawn up his Will dedicating all his considerable wealth to religious charities, bounties to the poor, to seminaries of Sanskrit learning and other objects of general benevolence. Such was the remarkable career of a self-made man, who though born and brought up in poverty, rose by his own force of character and genius to be among the richest men of his time but who finally bequeathed all his riches for the service of humanity.

However the story of Pachaiyappa Mudaliar is not over with his death. In those days Wills were almost unknown and their validity was scarcely recognized. The consequence was that there was long drawn out litigation and the provisions of Pachayappa's Will were not carried out for the next 40 years! It is to the credit of the successive Advocate Generals Sir Herbert Crompton and Mr George Norton that the Supreme Court was moved and thus the bequests of Pachaiyappa were recovered. The Supreme Court in the exercise of its equitable jurisdiction in a further decree passed in 1841 prepared a scheme, whereby by a liberal interpretation of the provisions of the Will, directed that all accumulations beyond one lakh of pagodas (four and a half lakhs of rupees) should be devoted to educational establishments in various parts of the presidency, and particularly in the city of Madras. A body of trustees was created to administer the endowments.
A school was established in Madras in 1842, which grew into Pachaiyappa's College. The foundation of this institution marks an era in the educational history of South India, as it is the first example of Indian munificence and enterprise devoted to the cause of education.

**Annamalai Chettiar (1881-1948)**

Annamalai Chettiar (see Note 49) was born in 1881 at Kanadukathan in Ramanathapuram District of Madras Presidency. He was a rich and influential banker, but devoted a considerable part of his life to the cause of education and donated princely sums in the creation of educational institutions in the South.

Annamalai University owes its existence to the farsighted vision of a single individual – Annamalai Chettiar. As early as 1918, he founded the Sri Meenakshi College at the great pilgrimage centre of Chidambaram in the South and in 1928 Annamalai University started with this college as the nucleus. This was the first unitary residential university in the South. Until his death in 1948, he guided the destiny of the university by paying meticulous attention and immaculate care to its growth and development. As a result Annamalai University attracted scholars, scientists and mathematicians of great renown.

Some further details of Annamalai Chettiar's life provide interesting vignettes of his character and personality. Although he got a thorough grounding in banking which was the family business from his father early in life, it is through his indefatigable energy, systematic work and attention to detail that he rose high in business. Such was his driving power and force of example that his firms and businesses ran without a hitch and prospered exceedingly. With fuller profits, he decided to lead, not an easier, but a fuller life. He toured extensively in India, Burma, Ceylon, Malaya and Europe and on his return he enlarged his sphere of activities. He became chairman of the Karaikudi Union, member of the District Board and in 1916 member of the Madras Legislative Council. He took all these responsibilities seriously. When he was chairman of Karaikudi, he used to drive to Karaikudi in a magnificent carriage drawn by horses, go around the town, give orders and seeing them carried out, return to Kanadukathan, while to most of the townsfolk, the day was just beginning! On hearing of a highway robbery of the government mail, he, with a handful of men, scoured the country and apprehended the offenders.

He was convinced that education was the prime need of the country. He consulted the Right Honourable V S Srinivasa Sastri and other educationists and finally decided to locate an educational institution at Chidambaram. Once he made the decision, there was no delay in carrying it out; with Annamalai Chettiar, to decide was to act. Sri Meenakshi College started in 1918 in extended premises of a school, but new building plans were made. Annamalai Chettiar threw himself into the work heart and soul. He was personally involved in the building project, but in purely academic matters he trusted implicitly his educational advisors such as K A Nilakanta Sastri (1892-1975), the well-known historian, whom he had appointed as the first principal of the college. The college grew steadily in reputation and popularity. So good was its work and so high in standing in the educational world that Sir Annamalai conceived the idea of developing it into a university. Everybody including Lord Goschen, the Governor of Madras, supported the idea.

The Annamalai University Bill was passed in 1929 and the university was born in the same year. The inauguration of the Annamalai University was a major event in the educational history of South India. The Right Honourable V S Srinivasa Sastri was appointed the first Vice-Chancellor, but because of an assignment elsewhere, he took it up only in 1935 and guided the university for the next five years. By the distinction of his personality and his devoted work Sastri enhanced the status and reputation of the university. The Annamalai University is the biggest endowment ever made by a single individual in this
part of the country, and by all accounts one of the first four or five leading endowments in all India up to that time.

The colonial government had earlier showered honours on him such as the knighthood and the title of Dewan Bahadur. In 1929, the high and unique distinction of a hereditary Raja was conferred upon him. During his life, he received appreciation from many men of distinction. In 1941, Rajaji (1878-1972) said 'In him we can see one who knows by instinct how to move among men of different views, how to be big and powerful yet preserve untarnished one's courtesy and humility of mind and speech, how to be a gentleman in the difficult sense of the term'.

Alagappa Chettiar (1909-57)

Rm Alagappa Chettiar was born in 1909 at Kottaiyur in Ramanathapuram district of Madras Presidency. After getting an M A degree in English literature from Presidency College, Madras, in 1930, he went to England and qualified for the bar. On returning, he launched into a business career which reached stellar heights. When he passed away prematurely at the age of 48, he had redefined philanthropy and contributed more to the advancement of education in Tamil Nadu than any other person had done (save perhaps Annamalai Chettiar). No wonder Jawaharlal Nehru called him the 'Socialistic Capitalist'.

Among the institutions that owe their existence to him are the Alagappa Chettiar College of Technology, a premier institution for chemical and textile technology which functioned as a part of Madras University (for two decades before it became one of the nuclei for the Anna University), Ramanujan Institute for Mathematics which ultimately became the Ramanujan Institute for Advanced Study in Mathematics of the Madras University and the group of colleges in Karaikudi that now form the Alagappa University.

Lakshmanaswamy Mudaliar (1887-1974)

The philanthropists apart, there were some remarkable Indian personalities who had a substantial role in running and developing institutions of higher learning, bringing to their work exceptional abilities and vision. Asutosh Mookerji was responsible for raising Calcutta University to great heights of excellence during his tenure as Vice-Chancellor there. The poet and Nobel laureate Rabindranath Tagore (1861-1941) created the Viswa Bharati University.

From the South, there were names such as C R Reddy, M Visvesvarayya and Sarvepalli Radhkrishnan who made signal contributions to the promotion of higher education in this part of the country. One name that stands out, particularly in the context of the University of Madras is that of Arcot Lakshmanaswamy Mudaliar.

Mudaliar was born in 1887 as the younger of twin brothers, the elder being A Ramaswamy Madaliar. Together the Arcot brothers blazed an unmatched trail of achievements in both private and public life for over 50 years. A L Mudaliar was one of the greatest obstetricians and gynaecologists of his time. His magnum opus, Clinical Obstetrics, was first published in 1932 and may still be in use. In 1939 he became the first Indian Principal of the Madras Medical College. Mudaliar was appointed Vice-Chancellor of the University of Madras in 1942 and served the institution in that role with great distinction for the next 27 years. Given his excellent track record he would probably have continued longer but for the government enacting legislation limiting the tenure of a Vice-Chancellorship. During these years he acquired a formidable reputation as an outstanding educationist in the South and the university during his tenure performed at a superior level. Much of the quality research work in the scientific departments that we have mentioned above were carried out in his days as the Vice-Chancellor and received support and encouragement from him. It was his initiative that resulted in what must be considered the best ever appointment to a professorship at the university – that of G N Ramachandran.
Lakshmanaswamy Mudaliar's great contribution was to make the University of Madras a premier Indian institution with a worldwide reputation. He was instrumental in creating and nurturing the Guindy Campus, to which the Engineering College had moved in 1920. Mudaliar shifted the physics and chemistry departments there so that ultimately the Guindy Campus grew to be the science campus of the university. He inspired two industrialists, Alagappa Chettiar and C Rajam, towards their philanthropic donations and midwifed the births of the Alagappa Chettiar College of Technology (1944) in the Guindy Campus and the Madras Institute of Technology (1949) in Chromepet. Another addition to the Guindy Campus was the Central Leather Research Institute of the Council of Scientific and Industrial Research, in April 1948, whose establishment as a university institute Mudaliar had suggested in 1945.

Mudaliar worked closely with Alagappa Chettiar in the creation of the first College in Ramanathapuram District in 1947, in the scrub jungle around Karaikudi, which ultimately became Alagappa University and in the creation of the Ramanujan Institute for Mathematics in 1950. Mudaliar drew up plans for a separate campus with a hospital in the outskirts of Madras for the study of Basic Medical Sciences, but this came to fruition only after his tenure as Vice-Chancellor. He passed away in 1974, aged 87, but his passion for teaching and the practice of medicine never waned until the end.

Comments on the Sociological and Colonial Context

Social attitudes to education in pre-colonial days

Respect for learning and scholarship was very much a part of Indian, in particular Tamil, tradition. Ancient texts lay great stress on the importance of (liberal) education. There was however, among certain sections of the society, an indifference to theoretical knowledge exemplified by the Tamil proverb ‘Ettu suraikkai kariyku udavadu’ meaning ‘The (description of the) gourd in the book cannot be cooked to be eaten’. Poet Avvai’s admonition ‘Enn ezhuth igazhel’ – ‘do not run down numeracy and literacy’ – suggests that the indifference to education was prevalent among a sizable section of the society.

The divergence in attitudes to learning was perhaps along caste lines. The brahmins certainly set great store by learning and education and the caste ideology denied education to the lower castes. But formal liberal education (before the advent of the British) meant mostly the study of literature and religious works. Exposure to advanced (theoretical) secular knowledge was through informal instruction and resulted from individual initiatives of the teacher and the taught and this certainly put the lower castes at a great disadvantage in the acquisition of (theoretical) knowledge. Professional knowledge was gained through in-house training in the profession and was on offer only to particular castes, as professions themselves were determined by caste. It must however be pointed out that advanced literary studies were by no means the preserve of the brahmins; practically all the great literary figures in Tamil literature were non-brahmins.

Learning was important for the brahmin as it was a prerequisite for the practice of his standard professions – that of the priest or teacher – and was thus linked to economic empowerment while the caste ideology ensured social empowerment. Some brahmins served also as advisers or consultants to political and military leaders (who themselves were mostly non-brahmins) and wielded substantial power; but this was evidently sustained only with the support of the higher (land-owning and trading) non-brahmin castes. The brahmin in literature and folklore is mostly an indigent teacher or priest which suggests that their power was in any case not conspicuous.

This was the general state of affairs when British education arrived on the scene. And the introduction of the new paradigm in education had far reaching sociological consequences.
The colonial system - major breaks with tradition

Perhaps the most important feature of the mode of education introduced by the colonial administration was that it offered the same education to all castes, a new experience for the subcontinent. Western liberal ideas propagated through the new education exposed the reprehensible iniquities of the caste system giving voice to the latent resentment against it on a wide front. British modes of administration made their education system an instrument for empowerment (once again bypassing caste, in principle): the educated could secure employment with the colonial government leading to economic as well as social empowerment. The system of course made English the common language of communication among the intelligentsia across the subcontinent. The feature that is most relevant in our context is that science was a routine part of the school curriculum and was on offer for more specialised study at higher levels (this was perhaps a relatively recent development even in Europe).

Indigenous initiatives along the colonial models

Most of the educational institutions offering Western style education were the creations of the colonial administration or of Christian missions headquartered in the West. With the steadily increasing influence of the colonial administration on every aspect of life, traditional style educational institutions became increasingly irrelevant and survived precariously - if at all - mainly catering to the needs of religion. The first indigenous effort to set up a higher educational institution following the British models was the founding of the Hindu College by Raja Rammohun Roy\(^9\) (1772-1833) in Calcutta in 1817 (which later became the Presidency College). Another notable initiative was the creation of the Mohammedan Anglo-Oriental College (which was later to evolve into Aligarh Muslim University) by Sir Syed Ahmed Khan\(^9\) (1817-98) in 1875. The next year, 1876, heralds the beginning of scientific research in the country: Mahendra Lal Sircar set up the Indian Association for the Cultivation of Science (where decades later Raman carried out his Nobel Prize winning work) in Calcutta in that year. In the South there was Pachaiyappa's College which we have written about in an earlier section above. J N Tata's\(^3\) (1839-1904) munificence and perseverance resulted in the establishment of the Indian Institute of Science in 1909 (which unfortunately, that visionary did not live to see).

The twentieth century saw some linkages between the nationalist movement and education, but this was happening in the East and North, not in the South. The Herculean efforts of Madanmohan Malaviya (1861-1946) (a stalwart of the Indian National Congress) gave birth in 1916 to the Benaras Hindu University. The great poet Rabindranath Tagore's (1861-1941) foray into education resulted in the creation of the Viswabharathi University at Santiniketan (in 1921). Scientists like Jagdish Chandra Bose\(^3\) (1858-1937) and Prafulla Chandra Ray\(^3\) (1861-1944) were not shy of articulating their sympathy for the nationalist cause. There does not seem to have been a similar linkage between educational initiatives and the freedom movement in the South. The southern maharajas who set up universities were of course not supportive of the movement. Nor were Annamalai Chettiar or Lakshmanaswamy Mudaliar particularly sympathetic to it. Great southern nationalists like V O Chidambaram Pillai\(^4\) (1872-1936), Rajagopalachari (Rajaji) or Subramanya Bharathi\(^5\) (1882-1921) evinced no great interest in education nor did the great scientists articulate their latent sympathies to the freedom struggle.

Caste and reservation policy

The radical departures from the traditional caste-dictated education pattern notwithstanding, the initial outcome of the introduction of the colonial education system was a tremendous rise in the power of brahmans. They were the ones - thanks to the importance they attached to learning - who took to the new education avidly and reaped the benefits of empowerment. By mid-nineteenth
century there was a preponderance of brahmins in the subordinate government services and they were rising to ever greater heights in the colonial administration. The new education opened up for them also careers in other elite domains: education itself, law, medicine and science, where too they became dominant.

The increased power wielded by the brahmins was no longer dependent on the patronage of higher non-brahmin castes (as it was in the earlier era). In such a context the superior status accorded to them by the caste system became much more intolerable than before. A socio-political movement arose to counter this concentration of power in the hands of the brahmins. The Justice Party\textsuperscript{96} which was the formal arm of the movement and a supporter of the ministry formed by the Independent Party in the Madras Presidency lobbied successfully to introduce (in 1927) a quota system for government jobs which is the precursor of the policy of reservations. The system provided quotas in jobs for various communities with a quota for brahmins too. It was indeed an effective step towards curbing brahmin power though the main beneficiaries in the early days belonged largely to the 'creamy layer' of the upper caste non-brahmins.

The quota system of 1927 did not distinguish between castes within the non-brahmin fold. Reservations for the dalits and the ‘backwards’ came only in the wake of independence as also reservation for them in access to higher education. These reservations – in jobs as well as educational opportunities – have no doubt helped in empowering previously disadvantaged groups.

The scientific scene and the caste

One striking fact of the South Indian scientific skyline is that all the stars of science from the south, Ramanujan, Raman, Chandrasekhar, Krishnan and Ramachandran were brahmins. All the outstanding mathematicians from the south (see earlier section above) except Fr Racine and S S Pillai were brahmins. The brahmins who are less than five percent of the population in South India produced almost all the peaks of excellence in mathematics and science. There were a few non-brahmins (like for example, A.L.Mudaliar) who rose to great heights, but high performance in science appears to have been by and large the domain of the brahmins in the first half of the 20th century. The brahmin – non-brahmin conflict which has been a major factor of the socio-political developments in the country's South over the last century has of course been the subject of extensive sociological studies, but there is a case for a focussed examination of its relevance and effect on science in the South. We offer below some brief comments on the subject.

As has already been observed, the introduction of the new education system resulted in a phenomenal rise in brahmin power at the expense of the higher non-brahmin castes. There were quite a few higher caste non-brahmins among the early graduates of the University of Madras with some attaining high positions in different walks of life. Despite this, unlike in the brahmin community, the enthusiasm for higher education did not spread to the rank and file, even among the higher castes. One positive feature of the brahmanical tradition was that it encouraged the pursuit of knowledge for its own sake; this attitude towards learning perhaps goes a long way in explaining the brahmin success in science. Unfortunately this ideal of knowledge for its own sake does not seem to have permeated significantly to other sections of the society. The policy of job reservations which was successful in altering the balance in caste representation in certain fields failed to achieve that in science.

The current situation

The perception that the brahmin enjoyed a decisive advantage over others in the pursuit of education by way of the support offered by his social and family milieu (and thus had an edge when competing for empowerment) is the rationale behind the reservation policy. However that policy did not help
inculcate a love for learning for its own sake in the student (which tradition had done for the brahmin). And it lowered the threshold of that important agent for promoting excellence – competition – for the beneficiaries of the reservation system.

There is another way in which reservation policy, however compelling the reasons behind it have been, had a negative effect on the pursuit of science: it did entail a compromise in standards in the teaching profession. This resulted in students not getting the best possible support system in terms of teacher quality: good teachers are a crucial input for the successful nurturing of talent especially in science. This was particularly unfortunate for students who were beneficiaries of reservation in access to higher education; good teachers were essential for them to off-set the lack of support from their social milieu.

As already stated, job-reservation did indeed bring some empowerment to the disadvantaged classes. However it has not delivered on what is supposed to be its broader objective: the disappearance of caste. Perhaps it has even encouraged the caste divisions to persist – there is advantage to be gained in proclaiming the caste identity.

It is true that the family and social milieu of the typical backward caste student is not as supportive of educational ambitions as that of his/her brahmin counterpart. This is indeed a serious issue and is especially crucial in the school years. Unfortunately the state has done very little to address this. The remedy is uniform good quality education to all children and it should be free as well as compulsory. Schools run along proper lines would make education a pleasant and exciting experience and students belonging to disadvantaged groups can make up for the lack of support from their social milieu; and those among them aspiring for higher education would then be able to handle the competition without the crutch of reservations.

Once the link between education and economic empowerment became clear to the society at large, the ideal of knowledge for its own sake was given up. There have always been a few die-hard adherents to that ideal but their numbers have been dwindling (at least as a percentage of our population). Higher education has come to mean to our society at large, almost exclusively education that leads to professions with ever increasing emoluments. That perception certainly makes reservation attractive to the ‘backward’ castes and it is arguable that that it has in turn contributed to encouraging that perception; even more important however in fostering that perception have been the effects of economic liberalisation of the recent years. Hence pursuit of basic science is not a much sought after career option for our youngsters. In such a context, it is hardly surprising that in the post-independence period our peaks in science are not as numerous or as high as one would have hoped for, on the basis of the track record of the colonial period.

Equally disappointing is the current performance of our wealthy industrialists in philanthropy (for the promotion of science) when one compares them with their pre-independence counterparts. Nor has the political class emulated the kind of interest in fundamental science shown by our first Prime Minister.

13. Acknowledgements

Writing this chapter has been an interesting and rewarding experience to us and we would like to thank Professor Uma Dasgupta for inviting us to write it.

We would like to express our gratitude to the following who shared with us their knowledge of the history of institutions in Madras and guided us to relevant source material: Mr S Muthiah, the historian of Madras, Professor S P Thiagarajan, Former Vice-Chancellor of Madras University, Professor P R Subramanian, Head, Dept of Nuclear Physics, University of Madras, Prof S Parvati, Director, Ramanujan Institute, University of Madras, Professor K Manibhushan Rao, (Retired)Professor, Centre for Advanced Study in Botany,
We thank Uma Rajasekaran for going through our earlier drafts and making a number of corrections and suggestions. V Nandagopal helped us with handling the word file of the manuscript and also proof read the last draft and helped correct the errors. We owe thanks to him for this invaluable help.

Notes

1. Throughout this narrative, the place names that are used will be those that were current during the period in question. In case the name has since been changed we indicate the new name in parenthesis when the name appears in the text for the first time.

2. The dates of the "Sangam" literature have not been conclusively established. Traditional belief dates the "Sangam"s as pre-Christian era events; other historical evidence however is available only on their having been one sangam (the last one according to tradition) though.

3. Tholkappiam is accepted as being among the earliest of tamil literary works. Scholarly opinion about its date varies from the third century before Christ to the early centuries of the Christian era.

4. Silappadigharam is one of the "five great epics" of Tamil literature and only one of two of which a complete text survives. According to tradition the author was a Chera prince Ilangovadigal who opted for the austere vocation of a Jain monk.

5. Taxila is in the Punjab province of Pakistan, about 15 miles west of the Islamabad. Known then as Taksha-shila it was an ancient Hindu and Buddhist seat of learning dating back to the pre-Christian era.

6. Nalanda is located about 55 miles south east of Patna in Bihar India, and was a Buddhist centre of learning from 427 CE to 1197 CE. It has been called "one of the first great universities in recorded history."

7. Kanchi (now Kanchipuram), a town about 60 kms southwest of Chennai was the capital of the Pallavas from the 3rd to the 9th centuries CE.

8. Amaravati, a small town situated on the banks of the River Krishna in the Guntur District of Andhra Pradesh, was the capital of the Andhra Satavahanas who ruled from 2nd century BCE to 3rd century CE. It was the site of a Buddhist monastery.

9. Aryabhata (476-550 CE) is the first in the line of great mathematician-astronomers from the classical age of Indian mathematics and Indian astronomy. His most famous works are the Aryabhatiya (499) and Arya-Siddhanta.

10. Brahmagupta (589-668 CE) another great mathematician was the author of the Brahmasphutasiddhanta a famous work translated into Arabic in the 11th century CE.

11. Nagarjuna (c, 150-250 CE) the founder of the Madyamaka school of Mahayana Buddhism was arguably the most influential Buddhist thinker philosopher after Buddha himself.


14. The main campus of the Indian Institute of Astrophysics (I I A), a premier national institution for research in astronomy and astrophysics is located at II Block, Koramangala, Bangalore 560 034, INDIA. The Kodaikanal (Solar) Observatory is run by I I A.

15. See Section 4 for more on the Survey School and the college of Engineering, Guindy.

16. One of the six Regional Meteorological Centres of the India Meteorological Department (established in 1875) is located at: 50 (New 6) College Road, Chennai 600 006.

17. William Petrie (d 1816) an amateur astronomer was a Fellow of the Royal society of London. The main aim of the observatory he set up was "to provide navigational assistance to the company ships and help determine the longitudes by observing the eclipses of Moon and satellites of Jupiter".

18. John Shelton of Shoe Lane, London was a famous clock maker. He made five astronomical clocks for the Royal Society of London for timing the transits of Venus in 1761 and 1769.

19. Captain Cook the famous explorer was a Fellow of the Royal Society. He took one of the five Shelton clocks (see Note 18 above) on his third voyage to the South Seas in 1776.
20. The survey started by Lambton was named the Great Trigonometric Survey of India only in 1818 by the then Governor General who took the Survey under his control. This was after the recognition accorded to Lambton first by the French Academy and a year later in 1818 by the Royal Society electing him to its Fellowship.

21. Colonel Sir George Everest was Surveyor General of India from 1830 to 1843. The Himalayan peak Everest is named after him.

22. Charles Michie-Smith was Government Astronomer at Madras (1891-1911) and Director of Kodaikanal Observatory (1899-1911) and was elected to the Royal Society in 1911. Earlier he was Professor of Physical Sciences at Madras Christian college (see Section 5).

23. Pogson discovered five asteroids and six variable stars while working at the Madras Observatory. A crater on the moon as well as an asteroid are named after him. He also participated in the Indian Solar Expeditions of 1868 and 1872.

24. Sir George Biddell Airy FRS, English mathematician and Astronomer, was Astronomer Royal from 1835 to 1881. Earlier he was Lucasian Professor of Mathematics at Cambridge university and then Plumian Professor and Director of the Cambridge Observatory.

25. John Evershed (1864-1956), eminent English astronomer became assistant director of the Kodaikanal and Madras observatories in 1906, later becoming director and holding the post till 1922. In 1909, he discovered radial motion in sunspots, a phenomenon called the Evershed effect which is perhaps the most important result of the early years to come out the Kodaikanal Observatory.

26. The telescope named after the distinguished Indian astronomer Manali Kallat Vainu Bappu (1927-82) is the largest optical telescope in Asia with a diameter of 2.3 metres. Vainu Bappu was appointed Director of the Kodaikanal Observatory in 1960 and became Director of the IIA at its 6. inception holding that position till his death in 1982. The observatory at Kavalur (in Tamilnadu), itself named after him now, was set up by him in 1968 and the telescope was built at his initiative, but he did not live to see it commissioned in 1982.

27. Our account about the University of Madras has drawn much from two sources: "History of Higher Education" in India, Vol I & II, University of Madras, 1957 and University News Vol 44 (2006), September Issue (devoted to the 150th anniversary of the University of Madras.


29. One of a series of Acts passed by British parliament for the regulation of the functioning of the Company in India. The Act abolished the monopoly of trading activities of the company making it an administrative body under the Crown. Among other things the Act also removed restrictions on Christian Missionaries for carrying on their missionary work. Section 43 of the Act assigned government funds specifically for education at a time when such funding was not available in Britain. It marks the beginning of active Western efforts at influencing morality in the subcontinent and paved the way for the reforms instituted by Bentinck and the pervasive adoption of Victorian values by large sections of the Indian middle-class.

30. Sir William Jones was an English philologist and student of ancient India, particularly known for his discovery of the existence of a relationship among Indian and European languages. He came to India as a "Puise Judge" to the Supreme Court of Bengal in 1783.

31. In 1781 Warren Hastings founded the " Madrasa 'Aliya", meaning "the higher madrasa".

32. Jonathan Duncan was the resident of the Company in Banaras. the college he founded eventually became Varanasi Sanskrit University in 1958 renamed Sampuranand Sanskrit University in 1974.

33. Lord William Henry Cavendish-Bentinck served as Governor-General of India from 1828 to 1835. Raja Rammohun Roy the "father of Indian renaissance" worked closely with him for social reforms such as the abolition of sati.

34. Thomas Babington Macaulay, poet, historian and a (Whig) politician became a Member of the British Parliament in 1830. He served as Secretary to the Board of Control (which oversaw the working of the East India Company) from 1832 until 1833. After the passing of the Government of India Act 1833, he was appointed as the first Law Member of the Governor-General’s Council. He delivered in 1835 the famous Minute on Indian Education in that capacity. He returned to Britain in 1838. His History of England is a much admired though incomplete work.


36. This "gist" is taken from the web-site of Presidency College Chennai: http://www.presidencychennai.com/history.html.

37. The full text of this "Public Address" is given in Appendix I in Volume 1 of "History of Higher education in South India", University of Madras, 1957.

38. Sir Powell remained headmaster/principal of the college till 1862.
39. This document drafted by the Court of Directors of the East India Company at the instance Sir Charles Wood (1800-1855), President of the Board of Control of the East India Company (during 1852-1855) is regarded as having laid the basis for the educational policy pursued by the colonial government. For the text of the document see: "Selections from Educational Records, Part II (1840-1859)". Edited by J. A. Richey. Calcutta: Superintendent Government Printing, 1922. Reprint. Delhi: National Archives of India, 1965, 364-393. It is also available on the web-site: http://www.mssu.edu/projectsouthasia/history/primarydocs/education/Educational_Despatch_of_1854.htm.

40. Major James Maitland an army engineer was Superintendent of the Gun Carriage Factory in Madras. He started his school in 1842. For more on him see the chapter by John Bosco Lourdeswamy in this volume.

41. Lord Dalhousie, Governor-General of India (1847-1856) was a dynamic administrator and ruthless imperialist. His methods of annexation of territory (military conquest and the "Doctrine of Lapse") were among the causes leading to the 1857 uprising.

42. The famous Yale University is named after him.

43. Robert Fellowes Chisholm, architect, was one of the pioneers of the Indo-Saracenic style of architecture. Chisholm also designed the Senate house of the University of Madras, another magnificent example of Indo-Saracenic architecture.

44. John Bourdillon Bilderbeck was a Professor of English and Principal of Presidency College during 1899-1906.

45. André Weil was one of the greatest mathematicians of the twentieth century and brother of Simone Weil, French philosopher and social activist. He spent two years (1931-32) as a professor at Aligarh Muslim University and retained a lively interest in mathematical developments in India.

46. Toppur Seethapathy Sadasivan, distinguished botanist was Director of the Botany Department of the university from 1944 till his retirement in 1973. Sadasivan was the President of the Indian Academy of Science during 1971-1973 and a recipient of the Padma Bhushan in 1974.

47. The Education Commission was set up by a government resolution on July 14, 1964. Its mandate was "to go into the question of National Policy on education in all its aspects and to prepare a plan accordingly for the next three plan periods, and also to suggest suitable machinery for its implementation". The commission began its task on October 2, 1964 and submitted its report on June 29, 1966.

48. Sir Mokshagundam Visvesvararaya a brilliant engineer administrator and statesman began his career as an Engineer with the Public Works Department of Bombay Presidency. After taking voluntary retirement (at the age of 46) in 1908, Visvesvararaya was appointed Dewan, of Mysore. The Krishna Raja Sagar (1924) dam across the Kaveri (the biggest reservoir in Asia), the first hydro-electric project (1902) in Asia at Shivanasamudram, the steel mills at Bhadravathi, the University of Mysore, the Government Engineering College (1917) (now University Visweshvararaya College of Engineering) at Bangalore and many other industries and public works owe their inception or active nurture to him. He was awarded the Bharat Ratna in 1955.

49. For more on Annamalai University and its founder see "Raja Sir Annamalai Chettiar Commemoration Volume", Edited by Narayanaswamy Naidu, Annamalai University Press, 1941.

50. Dewan Bahadur Sir Samuel Ebenezer Runganadhan was Professor of English at the Presidency College when he was appointed Vice Chancellor of Annamalai University. In the nineteen forties he was a representative of the Colonial Government in some international forums.

51. Rt Hon’ble V S Srinivas Sastri was a close associate of Gopala Krishna Gokhale (1866-1915) in the Servants of India Society. He was known as the "Silver tounge orator of the British empire" for his extraordinary eloquence (in English).


53. Dewan Bahadur R Ramachandra Rao was District Collector of Nellore (in Madras Presidency) when Ramanujan met him to seek help in December 1910. He was one of the founders of the Indian Mathematical Society (see Section 10) and served as its Secretary in the initial years and later President during 1915-1917.

54. Sir Francis Spring, who had served the Government for 33 years and retired as the Secretary of the Madras Government’s Railways Department, was appointed to oversee the development of the Madras harbour in 1905. He served in the post till 1919.

55. Subbanarayana Narayana Iyer was Chief Accountant of the Madras Port Trust when Ramanujan joined there. An amateur mathematics enthusiast, he was among the founders of the Indian Mathematical Society, served as its first Assistant Secretary (1907-1910) and later as Treasurer (1914-1928).

56. Sir Gilbert Thomas Walker FRS, was a British physicist and statistician is known for his description of the Southern Oscillation, a major phenomenon of global climate, and for advancing the study of climate in general. Walker was an established applied mathematician at Cambridge University when he become Director-General of Observatories in India in 1904.
57. Godfrey Harold Hardy was a major figure of twentieth century mathematics. He was the mentor for several Indian mathematicians apart from Ramanujan. His book "A mathematician's apology" is a delightful defence of the pursuit of mathematics for its own sake.

58. Professor Eric Harold Neville was appointed to the Mathematics Chair at University College, Reading in 1919 after his term as Fellow of Trinity was over. He seems to have concentrated on pedagogical matters from then on.

59. Pierre Deligne is a professor at the Institute for Advanced Study in Princeton. He was awarded the Fields Medal in 1983 for work that included the resolution of the Ramanujan Conjecture.

60. This is the book "A Synopsis of Elementary Results in Pure and Applied Mathematics" by George Shoobridge Carr (born 1837), who was a private tutor coaching students preparing for the Cambridge Mathematics Tripos. The book was published by C F Hodgson in 1880.

61. "Journey into Light" by G Venkataraman published (1988) by the Indian Academy of is Sciences, Bangalore is a comprehensive account of Raman's life and his science. "Scientific papers of C. V. Raman", Indian Academy of Sciences, Bangalore (1988) (Editor: by S. Ramaseshan) is a comprehensive collection of Raman's Scientific papers.

62. Die Lehre von den Tonempfindungen (On the Sensations of Tone) was a book (in German) by Hermann Ludwig Ferdinand von Helmholtz one of the foremost figures in science in the nineteenth century in 1863. What Raman possessed was probably the English translation made in 1885 by Alexander J Ellis from the fourth German edition. In Raman's view Helmholtz was the equal of Archimedes and Newton.


64. John William Strutt, 3rd Baron Rayleigh was a great English physicist who (with William Ramsay) discovered the element argon, an achievement that earned him the Nobel Prize for Physics in 1904. He also discovered the phenomenon now called Rayleigh scattering. His "Theory of Sound" in two volumes was published in 1877-78.

65. Connemara Public Library at Chennai is one of the four National Depository libraries which receive a copy of all books, newspapers and periodicals published in India. Established in 1890 the library houses centuries-old publications. The Library's beginnings go back to 1861, when hundreds of surplus books in the libraries of Haileybury College (where Indian Civilians were trained in England) were sent to the Madras Government which kept them in the Madras Museum and became a part of the initial collection of the public library named after the then Governor of Madras, Lord Connemara, who laid the foundation on 22nd March, 1890.

66. C V Raman, Unsymmetrical diffraction-bands due to a rectangular aperture, Philosophical Magazine, 12 (1906), 494.

67. R W Wood was Professor of Optics at Johns Hopkins. The American Optical Society has instituted a prize in his name.


69. William Thomson, first Baron Kelvin was one of the leading physicists and greatest teachers of his time. "Popular Lectures and Addresses" was published by Macmillan (London, 1894).

70. Dr Mahendra Lal Sircar, a medical practitioner, initiated the historic science movement in August 1869 by starting it as a science class at his residence every Sunday. A 8-page printed pamphlet he distributed to the public and the press evoked an enthusiastic response with over 80,000 rupees received as donations was the seed money for the Indian Association for the Cultivation of Science (IACS). The foundation stone at 210, Bow Bazaar Street, was laid by Sir Richard Temple (1826-1902), the Lt. Governor of Bengal (1874-1877) and Lord Rippon (1827-1909)), the viceroy (1880-1884) inaugurated the premises in 1884, when he contributed Rs.1,000 towards the endowment. The first staff consisted of Mahendarilal himself and Fr Eugene Lafont S J (1837-1904), a Jesuit priest of St Xaveirs' College. Mahendarilal was physician to Iswar Chandar Vidyasagar (1820-1891) and his medical advice was sought for treating the saint Sri Ramakrishna (1836-1886). IACS is now located at 2A&2B Raja S C Mullick Road, Kolkata 700032, INDIA.

71. Sir Taraknath Palit, lawyer and philanthropist donated fifteen lakh rupees to the Calcutta University to institute a chair in Physics or Chemistry. Raman became the first Palit Professor in 1917.

72. Asutosh Mukherjee was undoubtedly the most dynamic figure in Indian higher education. During his tenure as vice-chancellor Calcutta University (1906-14 and 1921-23), the university became a truly great centre of academic excellence. Sir Asutosh was responsible for Raman's appointment as Palit Professor.

73. Kameshwar Wall's "Chandra" (University of Chicago Press, 1991) is a very good account of Chandrasekhar's life.

74. A E Pierpoint's "Elements of geometry in theory and practice" (Longmans, London, 1906), a book on Euclid's geometry, was used extensively in Indian schools of the period.
75. Arnold Sommerfeld, (translated from the third German edition of "Atombau und Spektrallinien" by Henry L Brose) "Atomic Structure and Spectral Lines" (Methuen, 1923). Sommerfeld was one of the great physicists who pioneered developments in atomic and quantum physics.

76. Werner Heisenberg, yet another great name in Physics was awarded the 1932 Nobel Prize for Physics.

77. Philip Furley Fyson was a botanist and educator is the author of several works on the flora of the South Indian hills. He was the principal of Presidency college during 1925–1927.

78. For more information on Krishnan's life and science see Current Science, (Special Section: K S Krishnan Birth Centenary) Vol 75 (1998), 1197-1275; in particular the article by E S Rajagopal (pp. 1259-61). Also D C V Malik, Current Science, Vol 79 (2000), 665.


80. John Desmond Bernal is known for his pioneering of X-ray crystallography. He was equally famous as a political activist and for his deep involvement with philosophical, social and historical issues connected with science to which he brought a Marxist perspective. He is also known for his war work during the second world war: he was a joint inventor of the "Mulberry Harbours" - prefabricated military harbours - which were taken across the English Channel from Britain with the invading army in sections and assembled off the coast of Normandy as part of the D-Day invasion of France.

81. Francis Harry Compton Crick shared the 1962 Nobel Prize for Physiology or Medicine with J D Watson for their unravelling the structure of the D N A molecule.

82. Alexander Rich is the William Thompson Sedgwick Professor of Biophysics at MIT (since 1958) and Harvard Medical School.

83. Though most of the prime movers were from Madras Presidency, the society was head-quartered at Pune when it was founded. The first annual conference of the Society was held at Madras in 1916. The second conference was held at Bombay in 1919. From that time on, a conference was held every two years until 1951 when it was decided to hold the conferences annually. The Twenty Fifth conference of the Society, which was held at Allahabad in 1951, was inaugurated by Pandit Jawaharlal Nehru, the first Prime minister of India.

84. The Institute for Advanced Study in Princeton, New Jersey, USA is regarded as the premier institution devoted to fundamental research in mathematics and physics. Founded in 1930 by philanthropists Louis Bamberger and his sister Caroline Bamberger Fuld, its mission formulated by the founding Director A Flexner is the promotion of basic research. The institution regarded as a Mecca of mathematics by the mathematical community provides opportunities for visits there to young mathematicians enabling them to interact with its eminent permanent members. Amongst past Permanent Members are giants such as Einstein, von Neumann, Weyl.

85. Marshall Harvey Stone was an eminent American mathematician who made some fundamental contributions to Mathematical Analysis. He took considerable interest in Indian mathematics and helped many Indians make professional visits to the U S. He has visited India several time and died in Madras during his last visit in 1989.

86. C Rajagopalachari, popularly known as Rajaji or C R, was among the stalwarts of the freedom movement. He served as the Prime Minister of Madras Presidency (1937–1939) during the British Raj. In independent India he held the offices of Governor of West Bengal (1947–1948), Governor General of India (1948–1950), Union Home Minister (1951) and Chief Minister of the (then) Madras State (1952–1954).

87. Rabindranath Tagore, poet, playwright, philosopher, musicologist and painter won the Nobel Prize for Literature in 1913

88. Avvai (or avvaiyar) was the name of perhaps more than one Tamil woman poet. The line quoted is from "AATHICHODI", a string of one liners teaching ethics to children and is attributed to the one who was attached to the Chola court and lived in the ninth or twelfth century.

89. Raja Rammohan Roy founder of the socio-religious reform movement Brahmo Samaj and regarded as the father of the "Bengal renaissance" was a pioneer in the educational field as well.

90. Sir Syed Ahmed Khan pioneered modern education for the Muslim community in India. One of the most influential Muslim politicians of his time, Sir Syed was of the firm conviction that Western education held the key to progress for the community demoralised by the failure of the 1857 uprising.

91. Jamsetji Nusserwanji Tata was a pioneer in the field of modern industry in British India.

92. Jagdish Chandra Bose, scientist who pioneered investigation of wireless transmission for which he was not given credit for his discoveries in this field until much later. In later years Bose interested himself in plant life.

93. Acharya Prafulla Chandra Ray, the "Father of Indian Chemistry" apart from being a first rate
research chemist, was active in promoting the cause of freedom. His two volume of History of Hindu Chemistry won high acclaim. Ray also founded the company Bengal Chemicals in the face of obstruction from the British.

94. V O Chidambaram Pillai was popularly known by his initials, V O C (Vaa Vu Chi in Tamil) was a lawyer, and trade union leader involved in the freedom movement. He launched the first indigenous Indian shipping service between Tuticorin (now Thuthukudi) and Colombo – the Swadeshi Steam Navigation Company – competing against British owned firms thereby earning the ire of the rulers. A member of the Indian National Congress, he was charged with sedition by the British government and sentenced to life imprisonment and was jailed in 1908, but released in 1912. He was subjected to inhuman treatment in jail.

95. Subrahmanya Bharathi, Tamil poet, journalist and nationalist, who apart from composing stirring patriotic songs that became very popular also wrote intensely on subjects such as women's emancipation, caste and economic iniquity and other social issues. He spent many years in French territories in the subcontinent to evade arrest by the British colonial administration.

96. Justice Party was the popular name of the South Indian Liberal Federation, a political party whose main ideological plank was the curbing of brahmin power and the advancement of the non-brahmins. The party was founded in 1916. The party won a majority in the elections to the Madras Legislature in 1920 and introduced a resolution on the quota system. The quota system was implemented later by the Independent Party ministry (supported by the Justice Party) in 1927 by a government order labelled "Communal G O".