In this year of Halley's Comet which appears only once in two generations it is but fitting that we should commemorate one of our own men whose name flashed across the astronomical firmament like Halley's Comet itself when it appeared in 1911 viz Mr. Allen Abraham.

Mr. Allen had been teaching mathematics here since 1891. He had studied astronomy from Dr. S. W. Howland and Mr. W. E Hitchcock and had developed a taste if not passion for the subject and used to work out astronomical problems on his own. When the thought of Halley's Comet swam into his ken he devoted his attention to charting the path of this rare but periodic visitor. The issues of the Miscellany which in those days used to appear every term was full of articles written by him on the subject. He seems to have taken part in high controversy with European Astronomers. The point at issue in 1911 between him and them seemed to have been the time when the comet would come first nearest the earth. It is remarkable that as against the predictions of the Western astronomers Allen's insight and calculations were confirmed true by the comet's appearance. For this intellectual feat he was rewarded with a Fellowship in the Royal Astronomical Society which is a very high distinction.

It is impossible for any one of us to walk in his footsteps as none of us has Allen's versatility dedication and brilliance. It is perhaps because of this our celestial visitor did not tarry with us long this time.

— Editor
Allen Abraham of Jaffna College
returns to our ken with The Halley's Comet

Mr. A. Kadirkamar
Principal, Jaffna College

There is a renewed interest in Professor Allen Abraham and his studies in Astronomy with the reappearance of the Halley's Comet during the course of this year. Jaffna College now produces a publication giving more information in historical perspective of Allen Abraham as a man, an outstanding teacher of Mathematics, an Astronomer, a Tamil Scholar and a Christian Layman.

A publication of the Royal Astronomical Society giving a list of Fellows and Associates published in February, 1921 has the name Allen Abraham, B. A. Professor of Mathematics, Jaffna College, Vaddukoddai, Ceylon, first on the list in alphabetical order. On scrutinising the document I find that there were about 759 Fellows in 1921 and Professor Allen Abraham was the first native Ceylonese to be admitted as a Fellow of the Royal Astronomical Society on the 12th of January, 1912. There was one other person who was admitted to the Fellowship from Ceylon before Professor Abraham on 11-6-1909 and he was an Englishman, Alec Joscelyn Bamford B A. Associate Astronomer for the Government of Ceylon, Observatory, Colombo, Ceylon. The same document reveals that professor Allen Abraham was the 8th native Asian to be admitted to the Fellowship — which includes six from India and one from Japan. Taking into consideration all the other Fellows from Asia he was the 18th to obtain the Fellowship with seven Englishmen from India, and one each from Japan, Federated Malay States and Ceylon. But what is most interesting is that most of the others who were admitted as Fellows of the Royal Astronomical Society were all working in established technical institutions or observatories with many facilities available for scanning the skies and for making appropriate records, but Allen Abraham alias Subramaniam Amplavanar made his observations with a very small telescope (brought in probably by the original missionary astronomer to Jaffna College from U. S. A, Dr Daniel Poor in the early 19th century) aided also by observations of the naked eye with the help of his students and colleagues on plamyarh tree trunks, at Kaniitivu, Jaffna.

The following quotation from the Jaffna College Miscellany of first term, 1912 Volume XXII No: 1 under the heading, "Astronomy in Jaffna College" will be of some interest.

"Later Mr. Allen Abraham, a pupil of both Mr. Hitchcock and Dr. Howland, who obtained his B.A. degree in English, Philosophy and Mathematics, became the head of the Department of Mathematics. He has fully kept up the traditions of the chair by adding to his college teaching original work in calculating eclipses and writing articles on other astronomical phenomena. During the year 1910 while Halley's comet engaged general attention he was particularly helpful in diffusing information in regard to this and other phenomena..."
through popular lectures and articles in the papers and magazines.

Especially two points are to be noted to his credit in connection with the comet in his lectures on Halley’s comet. He predicted and explained with diagrams that the comet would be visible to the naked eye in the middle of April, 1910, while other astronomers thought that it could not be seen so soon. In fact the comet which was first observed in photograph on the 11th September 1909, by Dr. Wolf of Heidelberg, and in the telescope on the 19th of September 1909, by Prof. Burnham of Chicago, was first seen with the naked eye by Mr. Abraham on the 14th of April, 1910. He communicated the news immediately to the Colombo Press pointing out where to look for it in the heavens. It was seen at Khartoum on the 18th at Bombay and Kodaikanal on the 19th and in London on the 25th of April.

Again he pointed out in his lectures and explained with diagrams that the comet would enter into the orbit of Venus and reach so near it during the first week of May, that its motion would be retarded by that planet. This proved to be a fact which was neglected even by some of the most eminent astronomers in their first calculation of the time of the comet’s transit across the disc of the sun, and was noticed only just before the time of the transit after seeing that the comet had not advanced in its motion as rapidly as they first calculated. Mr. Abraham has indeed done real service in popularising Astronomy and amply deserved the honour conferred on him by a scientific society of such high rank as the Royal Astronomical Society of England.”

A biographical sketch of Professor Abraham outlining his family background and academic achievements at Tellipallai and Jaffna College appear elsewhere in this issue. While a student at the Tellipallai Training and Industrial School of the American Ceylon Mission he along with his classmates built the important land mark at the present Union College, Tellipallai — the SANDERS HALL as masonry was one of subjects for practical training then. (Unfortunately the name Sanders has been sadly obliterated from the building now).

Allen Abraham was the distinguished professor of Mathematics and Tamil at Jaffna College from 1896 to 1922 the time of his death. For a period during this time Jaffna College was affiliated to the Calcutta University. Some of his better known students during his last few years as Professor were Messers K. A. Selliah (Principal, Jaffna College), I. P. Thuraiaratnam (Principal, Union College, Tellipallai), L. S. Kulathungam (Vice-Principal, Jaffna College) and P. Sri Skandarajah (Supreme Court Judge). The fact that these able students were taught by a Professor of Mathematics as well as Tamil explains the ability of some of them in handling Mathematics as well as the Humanities — K. A. Selliah the able Maths and Physics teacher started teaching Tamil at Jaffna College while L. S. Kulathungam the great teacher of English and Latin
Allen Elected F. R. A. S.

BURLINGTON HOUSE, 
LONDON, W.

Sir,

I have the pleasure to inform you, that you have this day been elected a Fellow of the Royal Astronomical Society. The Bye-Laws relative to new Fellows, with which it is expedient that you should be more immediately acquainted, will be found on a subsequent page. The prescribed Form of Obligation, therein alluded to, is enclosed; and I have to request that you will return it to me at your earliest convenience, after having subscribed it with your Christian name and Surname, together with the addition of your Rank, Profession, &c., and your usual place of Residence; in order that they may be properly inserted in the printed List of Fellows. Enclosed, also, is a Card announcing the days on which the ordinary Meetings are held during the present session.

I have the honour to be
Sir,
Your most obedient Servant,
(sgd) S. A. Saunder,
Secretary.

PROFESSOR ALLEN ABRAHAM, B. A.
மாணா அமிதாப்பிள்ளை என்று கையாம்புதெரியின்
சிறந்த குரு படிகம் பதிவு செய்யும்
could handle Mathematics too to several classes.

Besides his scholarship in Tamil being known as “Allen Pandithar”. Professor Abraham excelled in the art of composing and singing Tamil verses and lyrics. He was a prolific writer and author and was also the Editor of the Morning Star from 1897 to 1909. He was also the Secretary of the Jaffna Council of South India United Church from 1915 to the time of his untimely death and was an excellent lay preacher too.

His greatest contribution was in the field of Astronomy and his calculations, predictions and lucid explanations about the movements of the Comet in 1910 brought him international fame and the prestigious Royal Astronomical Society of England elected him as a Fellow and thus he became the first Ceylonese to be recognised as such and inspire of such publicity given to the Halley’s comet in our news media Allen Abraham strangely seems to be forgotten!

Allen Abraham’s son Aruliah now lives in Rakka Road, Jaffna and very affectionately holds on to some of his fathers documents and certificates and proudly and ardently cherishes the memory of a truly great and devout father.

Some of the writings of Allen Abraham in English and Tamil are still available in his own handwriting while most of them have been published in the Morning Star or in the Jaffna College Miscellany. Some of these interest to the present generation are:


3. Articles in the 1910 Miscellany are of absorbing interest, namely: “Comets and their influence on the Earth” (March 1910 Volume XX) and “The Comet’s visit and after” (June 1910 Volume XY No. 2). The earlier article is also reprinted in the Centenary publication of the Miscellany of 1981.

4. Among some of the manuscripts found in his own hand-writing there is an article “On the Place of Astronomy in Elementary School Education” and another on “The Stars”.

The telescope he used for his observations had a 3½" objective and was 5' long when stretched. This telescope had much sentimental value to Jaffna College and was used by students and teachers in the Physics laboratory up to August, 1974 when it was forcibly taken away by the Jaffna University when the college was acquired and we believe that it is still in the Jaffna University. We are hoping that this telescope will be returned to us very soon. It will be a very kind and thoughtful gesture if returned.

While Allen Abraham returns to our ken along with the Halley’s Comet again in no unmistakeable terms, we stand awestruck and enthralled reading his writings and lecture notes. His erudite scholarship, clarity of thought,
beauty and eloquence of expression are most remarkable and heart-warming. People who still remember him speak of his base-baritone voice that causes tremors of emotion when the Professor sings in Tamil. There are still some who refer to the brevity and lucidity of the minutes he used to maintain, as secretary of councils, like the Jaffna Council of the South India United Church.

What a treat it would have been for his students to know him and to imbibe knowledge at his feet. His son, Aruliah sobbing uncontrollably while handing his father's invaluable documents to me last year related how his father used to sing with tears streaming down his cheeks a song of gratitude and praise to God for raising him to such great heights and achievements from the sheer dust of Karaitivu: "to proclaim the triumphs of Him who has called you out of darkness into this marvellous light"—if I may express it in the words of the Epistle to St. Peter (I Peter 2:9)

While recapitulating Professor Allen Abraham's astronomical studies and his commitment to Christianity, it may be relevant to refer to some observations in Professor C. A. Coulson's book "Science & Christian Belief"—"The Astronomer Kepler was sustained by the thought that as they work they are..." "thinking God's thoughts after Him......" ".....Science is an imaginative adventure of the mind seeking truth in a world of mystery". In Canon Raven's words "Life abundant is both the goal of evolution and the purpose of Christ" and that "For mankind there are two unique sacraments which disclose the meaning and convey the experience of reality: they are the created universe and the person of Jesus Christ".

It is remarkable that we had in our midst a century ago such a genius and a scholar whose commitment to the academic and to Christ still remains a magnificent spectacle of all that we hope and desire to do at Jaffna College. He was more than aware of the college motto "Jesus Christ the Light of Life".
The starry heavens above
The moral law within”

These were the concerns of the great philosopher Kant and are engraved in a statue to his memory in the ancient city of Konisberg. It seems to me that these lines are also appropriate to describe the life and work of Prof. Abraham.

A quality that distinguishes the humans from the rest of the animal world is the capacity to recognise and to wonder at some of the great and beautiful works of creation. The starry heavens above have filled mankind from ancient times with a sense of wonder and awe. Reflections on the stars quickened man’s intelligence and led him on in that long road to learning and civilization. Marvel at the beauties of the creation led him on to adoration of the Creator.

The astronomical knowledge of the ancients had been consolidated by the great Ptolemy of Alexandria about two thousand years ago in great books which the Arab astronomers of a later date reverently called The Almagest. In the sixteenth and seventeenth centuries, science entered a new phase when a mathematical science of mechanics, applicable universally to terrestrial and celestial motions alike, came to be constructed through a scientific movement in which Copernicus, Kepler, Galileo and Newton were among the pioneers.

What they did changed man’s outlook towards the world and the universe. What had been looked upon as a chaos now became a cosmos, law abiding and predictable.

However, there were many sceptics who refused to accept that same simple mathematical theories and formulae could describe and limit the great wide universe, and confine the enormous heavenly bodies to specified motions. Some spoke from their prejudices and some from deep philosophical misgivings. Years later, Albert Einstein said:

“The most incomprehensible thing about the world is that it is comprehensible.”

Halley’s Comet, perhaps more than any other celestial occurrence, helped to convince that there must be something deep and true in the science of Mechanics. It had been believed that the occasional appearance of a comet portended some disaster—earthquake, famine, demise of rulers. When Edmund Halley applied Newton’s laws of Mechanics and his Inverse Square Law of Universal Gravitation to study the paths of some twenty comets for which accurate historical records were available, he arrived at the surprising conclusion that the comets of 1531, 1607 and 1682 had followed approximately the same orbits. He went on to assert that these comets were one and the same, that it made its periodic
appearance once every 75 or 76 years, and that it would appear again in 1758. This prediction was brilliantly fulfilled. By then Halley had died but his fellow astronomers named that comet as Halley's comet, in honour of the man who had demonstrated that the universe was law abiding and predictable.

The first time I heard about Comets was as a school boy at Hartley College. By that time the name Allen Abraham was something like a legend. Those who spoke about him added in the same breath some reference to Halley's Comet. Prof. Abraham had prepared the people of Ceylon and in particular the people of Jaffna for the expected appearance of this Comet in 1910. The Comet obliged with a magnificent display for several months. Those who had been privileged to witness it often spoke with great emotion and passion.

In our early introduction to science in the middle forms at Hartley, astronomical topics were often included. I can recall vividly now, some fifty five years later, some of the themes with which Mr. S. T. Samuel inspired us. If later in life, we had learnt to love science through the works of Newton, Maxwell, Einstein and Dirac, the early kindlings could be ascribed to the emphasis on science education which Prof. Abraham had brought to the Jaffna scene.

Halley's Comet is visiting us again. It is not expected to be so brilliant this time as in 1910. Here in Australia, visibility has required clear skies, remoteness from city lights and binoculars. It is expected to brighten by late March, 1986 and we would be able to see with the naked eye. As we look and marvel, we would think of professor Abraham whose life and work had testified to the glories and wonders of God and his Creation.
Allen Abraham Ambalavanar the Astronomer of Halley's Comet Fame

T. Visvanathan, B. Sc., Dip. in Ed.
Head of the Department of Science, Jaffna College

Halley an international Astronomer and a Scientist much respected by his contemporary Sir Isaac Newton made an astronomical study of the occurrence of a Comet and in 1704 predicted that the particular Comet would occur again in 1758. Though Halley was deprived of the satisfaction of realising the truth of his prediction on account of his death in 1742 his contemporaries did confirm his prediction by the observation of the Comet in 1758. The Comet had been named after him and it was observed subsequently in 1834 and 1910. The 1910 Comet was correctly predicted by the late Allen Abraham Ambalavanar, a member of the staff of Jaffna College who earned the distinction of being made a Fellow of Royal Astronomical Society of United Kingdom for his brilliant work. He has been the first Ceylonese to have been awarded the much respected International Fellowship. The certificate which was awarded confirming the fellowship is yet found in the Daniel Poor Library of Jaffna College, Vaddukoddai. Also the document of the Royal Astronomical Society of 1921 available in the same Library containing the names of others who were made Fellows states that he was the one and only Ceylonese to have been honoured thus then.

In the village of Karainagar, then called Karadive was born Subramaniar Ambalavanar (Allen Abraham Ambalavanar) in 1865 at Pairikoodal off Chakalavodai as the eldest son of Kanthapar Subramaniar and wife Parvathy. He had two younger brothers and a sister. Those were days when the villagers were mainly concerned with either farm or fishing or trade with South India. The 1876 cholera epidemic made Ambalavanar an orphan as both his parents had to succumb to death. Then the three children were adopted and looked after by their uncle Kanthappar Saravanamuttu. During this period there weren't any proper school at Karadive and so Ambalavanar attended a 'Thimai School' of Mrs. Sethi Nagamuthu. Having learnt his alphabets and some easy literature with her guidance he continued his studies under Karthigesa Aiyer and learnt higher and difficult literature and language under him. In December, 1881 he got selected to the then grant in Aid Training School at Tellipullai where he became a Christian. He finished the course in December 1883. Thereafter a notary and an old boy of Jaffna College took him to Jaffna College and made him follow the then five year Graduation Course of the Institution.

It was during the years 1884—1888 while being a student at Jaffna College Allen Abraham Ambalavanar's intelligence was spotted and he finished the course with a first class. While following the course itself he was appointed an instructor (a prestigious post at that time) at the said institution. After his graduation he
was appointed lecturer at the Tellipallai Training College. He had the distinction of having been welcomed as a lecturer of the Training College with songs specially composed for the occasion by the then students. They were really happy to have him as their lecturer but their hopes were short lived as he was appointed ‘Professor’ of Tamil at Jaffna College in 1891. During this period he passed the Senior Local in 1886 and the Madras Matriculation in 1889. The fact that he had a job, status and security did not prevent but on the contrary spurred him towards further academic pursuits. After having passed the F. A. of the Calcutta University in 1893 he continued his studies and followed it up by passing the B. A. Examination of the University privately by sitting for it in Jaffna itself. His performance at the Examinations is said to be unique. At this stage he was appointed ‘Professor’ of Mathematics as well at the institution. During this time Jaffna College got affiliated to the Calcutta University and was preparing student for the F. A. and B. A. Examinations. Then Mr. Allen Abraham Ambalavanar was their only teacher in both Mathematics and Astronomy.

By this time he got married to Muthachi, daughter of Suppar Sankarapillai (Chinnarni) and during his married life he had two sons (Kanagasuntharam and Aruliah) and two daughters, Jane Nallamma and Rose Rasamma. He lost his wife in his forties and got married again to Ponniah Thaiyamuthu. By his second wife he had no children.

Though Jaffna College had taught Astronomy right from the very inception of the Institution in 1823 it was Allen who continued to treat Astronomy as his hobby right throughout his life. He had written a number of articles to the Morning Star, Jaffna College Miscellany and even to the Royal Astronomical Society in United Kingdom Some of his article were:

“The Place of Astronomy in Elementary School Education”, “Halley’s Comet”, “Tropical Heavens” and “Wonders of the Heavens”.

He continued to observe the stars from Karaidive and made a Central Study of the Stars in the sky a number of times. At this time he had a Brahmin, Mr. S. Maheswara Sharma as his pupil to work out the calculations and to study the Astrological charts before finalising the Astronomical calculations. He triumphed and earned world wide recognition while making the necessary calculations regarding the appearance of the Halley’s Comet in 1910. He predicted that it would be closest to Earth on 19th May of 1910 between 9 a.m. and 10 a.m. This did happen and when the information and the necessary calculations of Allen were available to the Royal Astronomical Society he was made a Fellow of the Royal Astronomical Society an undreamt of honour for an ordinary teacher.

Apart from Astronomy he was interested in Music, Tamil Literature, Farming and Social work. His Lyrics (eight of them) are even now being used by the Jaffna Diocese of the Church of South India for worship. Then he could
also sing the Hindu Thevarams with both devotion and clarity. Once when Sir P. Ramanathan was invited to Karadive the crowd that assembled to hear Ramanathan was restless as the Guest Speaker was getting late. Then Ambalvanar rose to the occasion and sang some Hindu Thevarams which kept crowd spell bound and Sir P. Ramanathan expressed his astonishment at the way Ambalvanar performed.

Tamil was his firstlove. At Karadive he was called 'Pandithar' as he had an excellent knowledge of Tamil Language and Literature. He was an active member of the Ariya Dravida Bhasha Sankam which was then functioning under the Presidentship of the famous scholar Kumarasamy Pulavar of Chunnakam. The songs composed by Allen in Tamil for the week-end journeys to Eluvathivu constitute a much adored collection of work. He continued his interest in farming. A visit to his farm was part of his routine. He could plough and join the workers in sowing and threshing paddy. Thus he continued to identify himself with the villager and was willing to share their problems as well. As an active worker of the temperance movement he was successful in getting the toddy taverns closed at a very critical time when thuggery was the order of the day. He persuaded the Missionaries to build a chain of Tamil schools at Karadive and dig a well for the depressed class group of people there.

An address by a foreigner in Jaffna was then incomplete without Allen's Tamil interpretation. His eloquence in English and Tamil was without parallel. A number of his achievements were due to his wonderful sense of discipline in his daily activities. He would be up by 4-30 a.m. Leave Karadive by his bullock cart by 6-30 a.m. Reach Vaddukoddai by 8-00 a.m. Again he would start his homeward journey by 3-30 p.m. arriving at Karadive by 5-00 p.m. and attend to his other duties including farm work. It must also be noted that a critic by name Kallady Velan had composed satiric verses to ridicule him at the time when Allen was esteemed high by the people of Jaffna. Allen's prompt repartee in verse forced Velan to accept defeat.

As a teacher at Jaffna College he had worked under Rev. Hastings, Hitchcock, Brown and Bicknell. The period under Hastings and Hitchcock was one when Jaffna College was affiliated to the Calcutta University and he was chiefly a teacher of Mathematics. In addition he was also Treasurer of the Alumni Association and an active member of the Church. Brown's period was one of changes and Cambridge Examination came to stay at that time as the affiliation to the Calcutta University ceased. This also was the period when Abraham was deeply interested in Astronomy.

In 1914 Rev. Brown the Principal of Jaffna College left and Allen and Mr. T. H. Paramasamy resigned from their teaching posts at College. The reason behind Allen's resignation is said to be professional jealousy and rumour mongering by some irresponsible people. However when Bicknell took over Allen re-joined the staff and continued to work at College with his earlier zest. He was the main candidate and advisor of Bicknell. By this time Allen was the Secretary of the
Church Council and a representative of the Executive Committee of the Board of Directors. In early 1920's he convinced Bicknell of the urgency of the introduction of the London Inter classes, Bicknell accepted the suggestion and started the Inter Arts immediately but was hesitant about starting the Inter Science class started. However a year later the Inter Science Classes too were started. These classes were continued at College for a pretty long time till about 1964.

Allen A. Ambalavanar when admitted to Jaffna College as a fresher was admitted in a higher class than the other freshmen inspite of his scanty knowledge of English as his super-intelligence was obvious at the viva voce examination held for admission. In the first term itself his rank was first and he maintained it right throughout his student days at College. Also he carried away the first prize in all the subjects taught in his class, all the time.

Subsequently when he rejoined the staff of Jaffna College during Bicknell's period he was Secretary of the Jaffna Council of the S. I. U. C, from 1915 to his death. He was also on the Executive Committee of the Board of Directors of Jaffna College and the South India Church. Further he was the person behind the editing of the Miscellany and the Morning Star. Thus he was virtually functioning as a Vice-Principal though officially the appointment was not made. It is somewhat strange to note to that at the Board Meeting held in February 1923 after Allen's death the next Senior person Mr. J. V. Chelliah was officially appointed Vice-Principal.

Allen used to wear a verti and a coat and was simple in his habits, humble, kind and cheerful in his ways. He had the moral courage to speak out his mind frankly and boldly act without fear even when he knew that his action would bring him unpopularity. He was free from personal animosity and jealousy. His was a culture that was an excellent combination of the best of the East and West. He had a clear brain, grasped the essentials of problems quickly and unrearily. He was a born Mathematician and a great Tamil Scholar. He cherished nothing other than being a teacher and of all places Jaffna College must have been his top choice.

After more than three decades of devoted service to his Alma Mater he had to enter hospital in June 1922 to get an ulcer in his toe treated. He was warned for three weeks and at 5 p.m. on Friday, July 9th 1922 he passed away. His funeral took place the following day at Karadive at 3.30 p.m. His colleague Mr. J. V. Chelliah and the Principal, Rev. John Bicknell delivered the funeral oration. The senior students of the college drew the hearse from his residence to the grave yard. Who would fill the breach was the question raised by the Jaffna folks at the time of his death.

By November 11th this year the Halley's Comet will again be visible in Sri Lanka. It would be seen best in March next year. Arrangements are being made under the leadership of Dr. Cyril Ponnamperuma here in Sri Lanka to make observations of the Comet during this period. Developed
countries are to send space crafts to have a closer look at the Comet. But people who know Allen Abraham Ambalavanar who predicted its appearance correctly in 1910 have not cared much to remember or commemorate his memory and his services all this time. However, people of Karainagar have formed an Allen Abraham Ambalavanar Society and are getting ready to erect a tomb at the top end of the Allen Lane in the village as a symbol of their love and devotion to one who has really immortalised this little hamlet. None can gainsay that it is the bounden duty of the people of Jaffna, Jaffna Diocese of the Church of South India, Jaffna College and even the state itself to memorialise this humble Mathematician of Halley's Comet fame.

**Note:** The author of this article is Editor and Acting President Allen Abraham Ambalavanar Society, Karainager.
The Place of Astronomy in Elementary School Education

Allen Abraham, B. A., F. R. A. S.
Professor of Mathematics and Tamil, Jaffna College (1891 to 1922)

(This is an unpublished handwritten document found in the possession of Prof. Allen Abraham's son, Mr. A. Aruliah of Rakka Road, Jaffna. These notes seem to have been written for a lecture. The notes are written on the reverse of the marks sheet of some of his students of that period and the sheets are dated 1912 and 1913. It is interesting to note the names of some of the students they are: Messrs G. M. Kanagaratnam, A. W. Rasiah, P. E. Rajaratnam, S. S. Williams, etc; These notes have been copied out by A. Kadirgamar, Principal, Jaffna College, Vaddukoddai.)

Astronomy is a high and advanced subject. Its proper place is in the High School or College Education. When I speak of its place in Elementary School Education, I do not mean a deep or exhaustive study not even an elementary treatment of the subject but an introduction of the child into this world of knowledge so as to create an interest in the subject and to induce him to make self observations and study of things around him and to help him to understand the allied subjects such as geography. I shall treat it first as a part of nature study. Secondly as related to the study of Geography.

1. Nature study plays an important part in the education of children according to the educational schemes of modern times, though it has not been encouraged in all countries by the authorities responsible for our educational curriculum or by the parents and guardians who are anxious about the education of their children.

(1) Nature study creates in the child the habit of observation. The child is made to observe things for itself and compare and judge and draw inferences of its own. At the same time the child gathers a great amount of knowledge.

(2) His moral capacities also are developed. His view of the world is broadened. He sees the interdependence of things around him. He begins to take interest in life. He begins to have sympathy with living beings about him and enjoys life.

(3) He finds regularity, order and unity in the world and perceives the wisdom, power and benevolence of the creator and is filled with the spirit of reverence.

Nature study means not only the animal, vegetable and the mineral kingdoms but also the starry heavens. A study of the plants, animals and minerals...
with the wonders of the starry heavens left out will be incomplete. Children should be taught to look up as well as look below and around. Astronomy is the oldest of the sciences. It is the shine of the stars that the human race first learned to worship. One of the oldest books ever written in the world says, "Canst thou bind the sweet influence of the Pleiades or loose the bands of Orion?" The Hebrew Psalmist sings, "The heavens declare the glory of God and the firmament showeth his hand work." The Apostle Paul writes in one of his Epistles...... (This incomplete statement is written in very small letters, probably to be elaborated as an illustration for his lecture). By directing the attention of young minds to the heavens above we open to them one of the most pleasant fields of enjoyment. Once you introduce them into it, they would not like to get out of it.

In the heavens above we see, as some one has said, a book of 365 pages always open before us. It never gets old, never torn, never dogeared. All that have eyes without the distinction of age or sex or wealth can make a study of it and enjoy it. Even the baby on the mother's lap may be made to look at the starry heavens and lisp "moo!" and "soo!" All the nations of the world may study this book in their own languages.

We hear almost every year of new stars and comets being discovered. In 1918, a new star was discovered in the constellation Aquila. Among those that discovered the new star first, was Master Fernando Drummond Menezes de Jesus, a young lad of fourteen. At such a young age he had acquired the habit of surveying the heavens each evening. As he was conversant with all the known stars and constellations, he picked up the new comer as soon as it rose above the very clear horizon of Lisbon in Portugal. It is indeed a great means of mental and moral development and a great source of knowledge and enjoyment for children to watch the sky at evenings going over the principal constellations and the most brilliant stars and to recognise the planets and their movements among the fixed stars.

Though we commonly speak of the unchanging heavens, when we take into account the varying phases of the moon, the Kaleidoscopic motions of the planets, the wandering comets and the variable stars, it is also true that the heavens are changing always. It is the duty of the teacher to regulate and guide the observations of the child. Instead of desultory star gazing, the child ought to be made to have an orderly procedure in observing with definite aims and proper co-ordination. He must be taught to watch the sky at evenings, to recognise the planets and pick out the bright stars such as Sirius, Arcturus, Capella, Regulus and Aldebaran, going over the roll of familiar constellations, whose very names are melodious and whose histories are replete with myth and legend. Many of the constellations bear names belonging to the heroes, animals and objects of ancient mythology. Great must have been the deeds of these heroes to entitle them to a place in heaven among the gods. The teacher must supply the students orally the stories of the heavenly bodies. Take, for example, the
small constellation called Lyra, the Harp, which is in these days seen in the evening sky. Ancient mythology tells us that this was a wonderful musical instrument given a place among the gods because of the sweet harmony of its music. Its music led the king of the infernal Regions and the Fates to do the hero's bidding and moved rocks and trees to tears. But modern Astronomy tells us truths concerning our relation to this constellation that far surpass in wonder the tales of mythology. It is said that one of the most eminent Astronomers once said that if asked what is the greatest fact that human intellect has brought to light, he would say it is this namely, "Through all human history, nay from infancy of time our solar system, the sun and the planets including the earth and the moon—has been flying through space towards the constellation Lyra with a speed of which we have no example on earth" a velocity of nearly a million miles a day. Astronomers say that if after ages of travel we were to arrive in that region of space occupied by this constellation, we cannot be sure that its stars would be there, because Vega the brightest star of this constellation is known to be moving away from its present position with a velocity equal to that with which we are approaching it. Not only Vega but other stars also are known to be moving through space. (Footnote repeated: "One of the most ancient books included in the Christian Bible says " Canst thou bind the sweet influences of the Pleiades." Modern astronomy says that Alcyon one of the Pleiades is the centre.) How highly interested the children would be to know that Arcturus (Arcturus) which appears to us as a single star is in reality a galaxy of stars as revealed by the newest telescopes, several thousands in number forming a universe in itself and that is moving with a velocity of 20 million miles a day. How glad would they be to know that a train moving a mile a minute from the earth would take 40 million years to reach the nearest star, that light which, moving 186,000 miles a second, left some stars when Adam and Eve walked in the garden of Eden has not yet reached us; How many of our boys are able to locate the Pole Star at the tail end of the Little Bear, by producing the line of the Pointers in the Great Bear? How many of them have observed it to occupy almost the same position in the sky all through the night while all the other heavenly bodies rise in the East, go upwards, reach the zenith, move downwards and sink beneath the horizon. (Note: illegible reading "What an enjoyment it is to watch the motion of the moon among the twelve constellations and the 27 telestoph (stars).

Some people think that the telescope and other astronomical instruments are indispensable for the study of Astronomy. This is a wrong notion. The human eye is the astronomical instrument, provided by nature. How great was this instrument before the invention of the telescope. Quick as thought, in a glance it commands a widely extended field and in a few moments it surveys the whole course of the sky -In giving a grasp of the whole field showing the relation and connection of the different parts, it is superior to the telescope. In addition to the unaided eye the oldest astronomical instrument, there are a few simple appliances of great value for bighin-
ners. The plumbline, the protractor, the gnomon and the sundial belong to this class of simple instruments. They would put so much meaning into the subjects connected with them. A flood of light would be poured upon some of the dark places of Geography if the boys and girls be made to find the latitude of the school building by finding the elevation of the Pole Star by the protractor or by measuring the height of the gnomon and the length of its shadow or if they were made to determine the error of the clock from a reading of the sundial or by noting the transit of a star across the plumbline. The ancients had no astronomical instruments such as we have. They did much by the simplest of all astronomical instruments the gnomon. Much can be done with it in an elementary school. This is merely a vertical column of known height erected on a perfectly horizontal plane and the observation consists in noting the length of the shadow at noon at certain times of the year. By computing the zenith distance at noon on the days of the summer and winter solstices and by taking the mean between them they found the latitude of the place.

(Note: Here follows some very closely written notes and rough diagrams on how to use the gnomon with several alterations as guidance to the lecturer. The sequence of this part of the lecture has been numbered from 1—8, but found at different parts of the paragraph. It takes some time to decipher and place in some order. I have tried my best to put it in the following order)

(1) The exact time of noon on any day can be found by noting the moment when the sun's shadow is shortest.

(2) By the direction of the shadow at this moment the meridian or north and south line of the place also is fixed. This line may also be found by drawing circles around the gnomon and noting the time when the shadow just reaches the circle before and after noon. The line bisecting the angle between the two shadows will be the meridian. A line drawn at right angles to the meridian will denote the East and West line. Thus the cardinal points are fixed.

(3) By finding the day on which the noonday shadow cast northward is shortest or the shadow east southward is longest we find the date of the summer solstice (June 22). The date of the summer winter solstice is found by noting the day on which the noonday shadow is longest. (Dec. 22).

(4) The days on which the shadow cast by the rising sun is in the same straight line as that cast by the setting sun are the dates of the Equinoxes (Mar. 21 & Sept. 23)

(5) The interval between the days in Spring or Autumn when the shadows had the same length at noon gives us the length of the year. This is also determined by noting the interval between two successive summer solstices or two successive winter solstices.

(6) The altitude of the sun above the horizon, and its zenith distance at
any time can be determined from the triangle formed by the height of the gnomon and the length of the shadow. The angle at the extremity of the shadow gives the altitude and the angle of the top of the gnomon the zenith distance.

(7) The ancients determined the latitude of a place, the inclination of the ecliptic to the equator by means of the gnomon. How many of our students know that the sun appears a little larger in January than in July?

(7) (a) At an equinox the latitude of the observer is equal to the zenith distance of the sun. At summer solstice it is equal to the Zenith distance plus 23½, at winter solstice Zenith distance minus 23½.

(8) Half the difference of these angles will give the obliquity of the ecliptic to the equator.

(Explanatory diagrams on the use of the gnomon for purposes of the lecture)
Astronomy As Related To The Study of Geography

by

Allen Abraham

Astronomy is a description of the heavenly bodies and laws governing their motions. Geography is a description of the earth. As the earth is one of the heavenly bodies the study of geography closely connected with it becomes a part of the study of astronomy. Therefore, a description of the earth in relation to other heavenly bodies, that is Astronomical Geography must always form a part of the study of Geography as much of it is needed for geographical application.

Though some text books divide the subject of Geography into Mathematical, Physical, Political and Commercial Geography, some belonging to the modern school would add Geological and historical Geography, and treat under Mathematical Geography some aspects of Astronomical Geography, due emphasis is not laid on the relation of the earth to other heavenly bodies and the effects resulting from these relations. The name Mathematical Geography itself is a misnomer. It is not any mathematical aspect but the astronomical relation of the earth that is to be described and the division and the order of treatment of the subject must be (1) Astronomical Geography (2) Physical Geography (3) Political Geography and (4) Commercial Geography.

Political and commercial conditions of the earth are dependant upon the physical conditions such as climate, winds, rainfall and vegetation and the physical conditions are dependant upon the astronomical relations of the earth. Therefore astronomical geography forms the basis of the whole study of geography and a grasp of the astronomical facts which are helpful for geographical purposes becomes indispensable for the proper understanding of the physical conditions of the earth and consequently of the political and commercial conditions, I could conclude by putting together the astronomical facts which from the fundamental principles of the physical phenomenon of the earth which in turn influence the political and commercial conditions of the earth.

I shall show in the following paragraphs how the fundamental principles of physical geography depend upon astronomical facts:

1. The Shape and Physical Constitution of Earth.

1. The shape of the earth is not an exact sphere; it is what is called an oblate spheroid, the polar side being flattened and the equatorial regions being bulged. The equatorial diameter is 27 miles longer than the polar diameter.

2. The earth’s outer part or crust consists of two kinds of rocks, aqueous and igneous; aqueous rocks are stratified and are lying in a certain order resembling
beds of deposits formed by water. Igneous rocks are found distributed rather irregularly, disturbing and piercing through the stratified aqueous rocks resembling the rocks formed by active volcanoes.

3. Again the density of the crust is much less than the density of the whole earth, proving that the density of the interior is much greater than that of the crust of the earth.

4. The temperature of the earth is increasing as we go towards the interior. Hot springs and volcanoes and earthquakes indicate that the interior of the earth is in a very hot state.

5. The surface of the earth is not even, some portions are elevated while others are depressed, some as continuous and mountainous plateaus and others as oceans and lakes and low lands.

Now, how are these geographical facts to be explained? They are to be explained only by the astronomical fact that the earth was once in an intensely hot fluid state and came to the present condition by cooling down. The well known nebular hypothesis states that the solid matter which forms the earth, was once a part of a continuous intensely heated gaseous body extending from the centre of the sun to the outskirts of the solar system beyond the planet Neptune and having a diameter more than 6000 million miles. As this body slowly cooled and contracted, Neptune was detached and formed a planet. Ages after, Uranus broke away. Then Saturn, then Jupiter, then Mars, the Asteroids, the Earth, Venus, Mercury separated. When the earth broke away from the Sun, first as a ring, and formed a spherical body, it was a soft fluid body rotating on its own axis and revolving round the parent sun. By the daily rotation, it put on its flattened shape due to the bulging out of the equatorial regions which rotated with a greater velocity than those of the poles. As the earth condensed the heavier substances sank to the interior and the lighter ones floated outside, causing the crust of less density than the interior. As the process of condensation advanced, a solid crust was formed while the interior was in a molten state. On the crust, oceans and lands were formed, and the oceans caused sedimentary rocks. As the interior was hot, earth quakes and volcanic eruptions took place, disturbing and piercing them. It is thus that the heavier mineral wealth which was sunk in the interior was brought to the surface. (to which Mountains and valleys are due.) As the cooling is not yet complete, the interior is yet hot and the temperature increases as we go towards the interior. Earthquakes are movements of the earth's crust, and volcanoes openings in it through which pent up matter is forced up to the surface, are due to the internal heat of the earth. The distribution and maintenance of life are due to the cooling of the interior and contraction of the crust and the action of the subterranean heat.

2. The Phenomena of Day and Night

The earth appears to be at the centre of a great celestial sphere. The sun rises in the east, goes up, reaches
the meridian, goes down and sets in the west. At any time one half of the surface of the earth is in light and the other half in darkness. How is this to be explained? Does the sun really move round the earth? No. Astronomy teaches us that it is not the sun and stars that move round the earth, but that the earth rotates on its own axis from west to east once in 24 hours, causing the daily apparent motion of the heavenly bodies—the sun, moon and the stars—in the opposite direction. As the axis of rotation is almost perpendicular to the direction of the sun, all the parts of the earth’s surface are brought successively under the sun by an alternate light and darkness which we call day and night. If the axis were curved towards the sun, one half of the surface would have continuous light and the other half would be enveloped in continuous darkness.

3. Temperature

The relative position of the sun and earth causes on the surface of the earth temperature—the variations in temperature which directly or indirectly cause most of the various physical phenomena on the earth. The temperature decreases as we go from the equator towards the poles. The amount of heat received by the earth depends upon the direction at which the sun’s rays strike the various part of its surface. When the sun is higher, the number of rays received by any particular area is greater then when the sun is lower, and when the sun is high, the rays fall on the surface of the earth more perpendicularly and consequently pass through less amount of the earth’s atmosphere, lose less amount of heat. This is mainly the reason for the variation of the temperature on the earth’s surface, from the burning heat of the tropics to the freezing cold of the snow-covered poles.

4. Day and Night

The length of the day and night is the same in all the places on the surface of the earth; neither the temperature nor the length of the day and night is the same in the same place at all times of the year. There is the change of the seasons, the summer and winter in the tropics, spring, summer, autumn and winter in the temperate zones. It is astronomy that explains these phenomena. If we watch closely the positional type sunrise and the sunset in relation to the stars we shall observe that the sun appears to have a yearly motion among the stars from the west to the east. The earth besides its daily turning on its own axis round the sun (sometimes the north pole, sometimes south, at one time sun is overhead on the equator then moves......) with its axis inclined to the plane of its path at an angle of 66½ degrees, and constantly pointing in the same direction. This causes the variation in the temperature in the length of the day and night and in the altitude of the midday sun during the year and this brings about the changes of the seasons, the sun rising and setting north of the equator during (one half). If the earth’s axis were perpendicular to the plane of its orbit, it is evident that as the earth rotates on its axis, every place on its
surface would have twelve hours day and twelve hours night. The equatorial regions would be hottest and the temperature would gradually decrease towards the poles. There would be no variation in temperature of any given place during the year and consequently no changes or seasons. But as the axis is inclined at an angle of 66½ degrees between the 21st of March and the 23rd of September, the sun is north of the equator, the North pole is inclined towards the sun and the regions round the North pole to the extent of 23½ degrees do not pass out of the sunlight, while the corresponding regions round the South pole are in continuous darkness; thus the North pole will have a day of six months duration and the South pole a night of six months duration, and the northern hemisphere will experience the spring and summer seasons and the Southern, autumn and winter. After six months, when the earth has accomplished half its journey round the sun, that is between the 23rd of September and the 21st of March, the conditions are reversed and the sun is south of the equator the south polar regions are in continuous light and the north polar regions continuous darkness, the south pole having a day of six months duration, and the pole a night of six months duration, the southern hemisphere experiencing spring and summer and the northern, autumn and winter. On the 21st of March and on the 23rd of September the sun is exactly overhead on the equator. The day and nights are equal everywhere. These positions on this account are called equinox, the position on the 21st March being vernal or spring equinox and position on the 23rd September being autumnal equinox. On the 22nd of June the sun reaches the northernmost limit and this position is called the summer solstice, and on 22nd of December it reaches the southern most limit and this position is called the winter solstice. On the 22nd of June the sun is overhead at places 23½ degrees north of the equator and the sun's rays reach a distance of 23½ degrees beyond the North Pole. A circle drawn round the earth at this distance north of the equator is called the Tropic of Cancer. The parallel at a distance of 23½ degrees from the north pole is called the Arctic Circle. On the 22nd of December the sun is overhead at places 23½ degrees south of the equator and the sun's rays reach a distance of 23½ degrees beyond the South Pole. The parallel of latitude at a distance of 23½ degrees south of the equator is called the Tropic of Capricorn and the circle at a distance of 23½ degrees from the South Pole is called the Antarctic Circle.

At places between the Tropic of Cancer and the Tropic of Capricorn the sun is overhead twice during the year. The seasons begin with the equinoxes and solstices, the spring on the 21st of March, the summer on the 22nd of June, the autumn on the 23rd of September and the winter on the 22nd of December. The inequality in the length of the seasons is due to the varying speed of the earth as it moves through the four quadrants of its orbit because it is not a perfect circle, but an ellipse having the sun in one of its foci.

5. Winds and Currents

The variation in temperature on the surface of the earth also causes wind
in the atmosphere and currents in the ocean. The atmosphere in the equator is heated and made lighter; this rises and overflows towards the equator. So the water in the equatorial regions is expanded and made lighter; thus there is a tendency for the warmer water to flow as a surface current towards pole. Again, a great amount of water is being converted into vapour; to replace this and the surface flow from the equator, a constant flow of colder and heavier water from the polar regions sets out as an undercurrent towards the equator. Thus Trade Winds and Anti-Trade Winds, Equatorial and Polar Currents are caused by the heat of the sun. Their directions are influenced by the rotation of the earth. The greater velocity of the equatorial regions make the Trade winds from the North and the South become the North-East winds in the Northern hemisphere and South-East winds in the Southern hemisphere, and the Anti Trade Winds from the equatorial regions become South-West winds in the Northern Hemisphere and the North-West winds in the Southern Hemisphere. Rotation makes ocean currents to deflect to the right in the Northern Hemisphere and to the left in the Southern hemisphere. The Gulf Stream and the Brazilian Currents are examples.

6. The Distribution and Maintenance of Life

The evaporation due to the sun's heat, the wind and the directions of mountain ranges cause the rainfall. The rainfall and varying temperature influence vegetation. Much high temperature and heavy rainfall cause the most luxurious equatorial forests and dense short undergrowths of the tropics, whereas moderate temperature and rainfall cause the high forests with gigantic trees in the temperate zone. It is the varying temperature that causes rice, millet, tapioca, cotton, rubber, sugar, coffee, tea, etc., to grow in the tropics, and wheat, barley, maize, oats, etc., in the temperate zone. The varying conditions of grass and plants govern the distribution of animals. All these again govern the distribution of human life over the surface of the earth and the formation of cities and countries and at last the agriculture, manufacture and commerce of the world.

How is life maintained? The sun is the supporter of all life on the earth. The earth is lit up by its beams and warmed by its heat. We receive from the sun not only light and heat but also chemical force which separates carbon from oxygen and thus provides separate food for animals and plants. It is the sun that builds up the vegetable world, Vegetation produces grain and grass on which men and animals live. So the energy of men and animals is supplied by the sun, and man and animal are only little machines directing the energy supplied by the sun. What is the source of the mechanical power moving large machines? It is steam which is produced by coal which again is the remains of ancient vegetation. Thus the sun is the source of all energy in the world. Thus to the benign influence of the sun are due our food, drink, clothing, light, heat and our very existence.

7. Sunlight

Sunlight, or the illumination of the sky which begins before sunrise and
continues after sunset, is caused by the reflection of light to the observers from the upper region of the earth's atmosphere. Its deviation is different in different latitudes. The greater the latitude, the longer is the deviation. This again is due to the obliquity of the eclipse. If the axis of rotation of the earth were perpendicular to the plain of the earth's revolution round the sun, the diurnal arc or the apparent path of the sun would cut the horizon at right angles in all the places. But owing to the slight inclination of the axis, the diurnal arcs are inclined at different angles at different latitudes. The duration of twilight depends upon these angles of inclination. It is found that the twilight lasts until the sun has sunk about 18 degrees below the horizon. The time required for this varies according to the latitude of the place. Near the equator the duration is shorter and in higher latitudes it lasts longer because the diurnal arc is at right angles to the horizon at the equator and is inclined more and more as the distance from the equator increases.

8. The Phases of the Moon and Eclipses

It is a study of the relation of the earth, moon and the sun that explains to us the phenomena of the phases of the moon and the eclipses. Just as the earth goes round the sun and the period of revolution constitutes a year, so the moon goes round the earth in a period of one month. But while the earth rotates on its axis once in 24 hours, the moon takes a month to rotate on its axis, so that it always presents to us the same part of its surface. The moon is a cold body and shines not by her own light but by the reflected light of the sun. Only the half of the surface formed towards the sun is lighted. As the moon moves round the earth, the side on which the sun shines is not always turned towards us. Only portions of the lighted half surface are seen by us, hence the phases of the moon which add so much to her beauty. When we are on the same side of the moon as the sun is, we see the whole of the lit up half and the moon is said to be full moon. When the moon comes between the sun and the earth, we don't see the lit-up portion at all and the moon is said to be new moon. The new moon and the illuminated portion waxes or increases till full moon and then wanes or diminishes till the next new moon. When the moon is midway between the new and full moon, presenting to us just half of the lit-up portion, it is said to be at the first quarter and the last quarter, the position just after the new moon, being the first and that just after the full moon being the last quarter. When a very small part of the lit-up portion only is seen during the week before and after the new moon, we get the crescent moon. When we see more than half of the lit-up portion during the week before and after the full, the moon is called gibbous moon. (If the moon's motion were in the same plane as that of the sun, during every new moon, the moon will put out the sun and there will be a solar eclipse and during every full moon, the moon will be hidden in the shadow of the earth, and there will be a lunar eclipse. But in reality the plane of the orbit of the moon is inclined at a small angle to that of the sun and consequently one half of the moon's journey is performed above the plane of the sun's path and the other half below. Therefore, only twice in each revolution the moon is in the plane of the orbit of the sun,
These positions where the path of the moon cuts the path of the earth are called the nodes. If the moon happens to be new or full moon at those positions, that is, in line with the earth and the sun, we shall have an eclipse, in our case a solar eclipse, in the other case a lunar eclipse. (The eclipses will be total or partial according to the distance of the moon from the nodes during new and full moon times.)

9. Ocean Tides

The phenomena of ocean tides are caused chiefly by the attraction of the moon and in a lesser degree by that of the sun. The attraction by the moon on the ocean nearest to it is greater than on the solid earth, and the water moves more freely than the solid land and is heaped up under the moon, causing high tide. Again the solid earth being nearer to the moon than the water on the opposite side is drawn away, leaving the water behind and thus causing another high tide at the same time on the opposite side. On the sides of the earth midway between these two portions as the water is drawn away there will be low tides. The rising of the water is called the flow or flood tide and the falling the ebb tide. As the result of the rotation of the earth there will be in every place of the ocean two high tides and two low tides every day. The interval will be 25 hours, owing to the motion of the moon round the earth. At new and full moon the sun, being in line with the moon and the earth, exerts its influence also in the same direction as the moon and thus causes every fortnight tides higher than usual. These are called spring tides. During the first quarter and last quarter the sun’s influence is at right angles to that of the moon and hence the tides are lower than usual and are called neap tides. The tides are of essential service to navigation. They carry the vessels in and out of port, and if not for them many ports in the world would cease to exist, being silted up by the rivers running into them.

10. Calendar and Time

It is astronomy that teaches us how to measure the flow of time into day, week, month and year. and to regulate the calendar. Without these natural measurements, clocks and watches cannot be regulated and their use would be impossible. The day is the time of rotation of the earth on its own axis. The days of the week take their names from the seven planets as the ancients understood them. The month is the length of the time of the moon’s revolution round the earth and the year is the time of the revolution of the earth round the sun. First the length of the year by astronomical calculations and then the number of months in the year and the number of days in the month are fixed so that the seasons may begin on the same days of the same months of the year.

11. Maps

It is astronomy that enables us to map the surface of the earth. No man can determine the shape of a continent or of an ocean by going round it. The map of a small country might be drawn by surveyors by measuring base lines and by the method of triangulation. But the maps of small countries are connected with the other parts of the earth.
surface by the help of astronomy. On the surface of an artificial globe representing the earth, lines of latitude and longitude are drawn. The latitude and longitude of the chief points of coastline, mountains, rivers, towns etc., are determined by astronomical calculations and remarked on the surface of this globe and the details are supplied by local surveys. Maps are mere reproductions of a part or the whole of this surface drawn to scale on a plane surface. The position of any place on them is defined by its latitude and longitude.

How do sailors and travellers find their way across pathless seas and unknown lands? It is by finding the latitude and longitude of their positions by observations of the heavenly bodies. Astronomers prepare four or five years in advance a book called the Nautical Almanac. The sailors take this with them. This book gives the places the moon, the sun and stars and planets occupy at stated hours of each day, and this information would enable the sailors and travellers to find where they are.

12. Astronomical Facts

(i) The earth was at the beginning in a hot fluid state.

(ii) The earth rotates on its own axis once in 24 hours.

(iii) The earth is a member of the solar system, being one of the planets revolving round the parent sun once in a year.

It is astronomical facts that cause the physical features of the earth and consequently influence the political and commercial connections. I shall show this in the following:

(iv) The ecliptic into the plane of the earth's equator at an angle of 23½.

(v) The axis of rotation of the earth is inclined to the plane of its path round the sun at an angle of 66½ degrees and consequently the ecliptic.

13. Astronomical Appliances

In conclusion I shall describe some simple astronomical appliances of great value to the study of geography. The gnomon, the protractor, the sundial and plumbline belong to this class of simple instruments every teacher of geography must be provided with. They would put so much meaning into the subjects connected with them. A flood of light would be poured upon some of the dark places of geography if the students, etc. (There must have followed some practical demonstrations after the lecture as the notes end abruptly).
THE TELESCOPE USED BY Prof. ALLEN ABRAHAM
Halley’s Comet and the Earth
(By Allen Abraham)

The diagram shows the relative positions of the comet and the earth from January to July, 1910, and explains how, moving in opposite directions, they approached each other until the comet came between the sun and the earth and transitted the sun’s disc between 9 and 10 a. m. on the 19th May 1910.

(Jaffna College Miscellany, June, 1910)
வாய்ப்பூர்ச்சி

அல்பர் அரிசார், B. A., F. R. A. S.

என்று வாய்ப்பூர்ச்சியால் பெறப்பட்ட விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன். வாய்ப்பூர்ச்சியின் மூலம் குறிப்பிட்டுள்ள விளக்கத்தில், வாய்ப்பூர்ச்சியின் பாரம்பரியத் தொடர்பான வரலாற்றுக்கு பதிவை செய்ந்துள்ளன்.
(Juno), (Ceres), (Pallas), (Asteroids) (Satellites)
(Moon) (Comets) (Nebula) (Constellations)
Astronomical observations at the turn of the millennium showed that the position of the Sun at the winter solstice was changing, indicating a shift in the Earth's axis. The shift was estimated to be approximately 100 arcminutes per century. This was confirmed by observations of the Great Comet of 1910, which was visible from the Earth's southern hemisphere.

During the winter solstice, the constellation of Orion is at its highest point in the sky, making it an ideal time to observe the star Alcyon. At this time, the constellation of the Pleiades is also visible, providing an opportunity to observe some of the brightest stars in the sky.

In conclusion, the winter solstice is a significant astronomical event that provides a unique opportunity to observe the changing positions of celestial objects due to the Earth's axial tilt.
The text in the image is not legible and cannot be accurately transcribed.
in the constellation 20 degrees from the south. They are identified with the:

- Argo Navis (Milky Way)
- Ursa Major (Great Bear)
- Ursa Minor (Little Bear)
- Cassiopeia (Wise Woman)
- Perseus (Piper)
- Orion (Hunter)
- Ursa Major (Great Bear)
- Ursa Minor (Little Bear)
- Gemini (Twins)
- Aries (Ram)
- Taurus (Bull)
- Cancer (Crab)
- Leo (Lion)
- Virgo (Maidservant)
- Libra (Scales)
- Scorpio (Scorpion)
- Sagittarius (Archers)
- Capricorn (Goat)
- Aquarius (Water Carrier)
- Pisces (Fish)

Clusters of stars are also visible:

- Pleiades (The Seven Sisters)
- Hyades (The Oxen)
- The Pleiades
- The Hyades

Other notable stars include:

- Aldebaran (Pisces, Orion)
- Betelgeuse (Orion)
- Rigel (Orion)
- Altair (Aquila)
- Procyon (Canis Major)
- Antares (Sagittarius)
- Pollux (Gemini)
- Castor (Gemini)
- Alcyone (Cassiopeia)
- Eta Carinae (Carina)
- Betelgeuse (Orion)
- Rigel (Orion)
- Altair (Aquila)
- Procyon (Canis Major)
- Antares (Sagittarius)
- Pollux (Gemini)
- Castor (Gemini)
- Alcyone (Cassiopeia)
- Eta Carinae (Carina)
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- Antares (Sagittarius)
- Pollux (Gemini)
- Castor (Gemini)
- Alcyone (Cassiopeia)
- Eta Carinae (Carina)
"நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும். இவ்வாறு வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

1. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

2. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

3. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

4. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

5. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

6. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

7. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரை�றைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

8. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

9. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

10. நாம் துணை மாணவர்களால் கீழே வரையறைப்பிய நிலைகள் கூறும்போது தொடர்புகள் கூறும் வரையறைப்பிய நிலைகளைக் கூறும் வடிவில் தரும் முடியும்.

(14 வருடங்கள் 1903-ஆம் ஆண்டு "சாலர் கிருஷ்ணா" என்று காட்சியில் பெரும் போக்கு தேர்வு செய்யப்பட்டது.)
கிருட்கால் கல்லூரியா அலுவல்கை

மு. சுப்பிரமணியன், M. A., B. D.

... மாணவர்களுக்கும் கல்வி மற்றும் மன்னர் உயர்வுத் தொடர்புடைய நிகழ்வுகளை குறிப்பிட்டிருக்கிறோம். அந்தக் கையிலிரு கால காரணங்களை கொண்டு மாணவர்கள் மிகவும் தொன்மையாக கற்றுக் காட்டும் நிகழ்வுகளைக் குறிப்பிட்டிருக்கிறோம். மேலும் கூறியுள்ளதும் கால காரணங்களை கொண்டு மாணவர்கள் மிகவும் தொன்மையாக கற்றுக் காட்டும் நிகழ்வுகளைக் குறிப்பிட்டிருக்கிறோம். அதையே கவனிக்கிறோம். மாணவர்கள் மற்றும் மன்னர்களின் பங்குப்பெற்றவர்களே முன்னேற்றம் செய்வப்படும் நிகழ்வுகளைக் குறிப்பிட்டிருக்கிறோம். அவை முக்கியமானவையாக இருக்கிறது. அவைகளில் உள்ள மாணவர்களின் மற்றையே முன்னேற்றம் செய்வதை குறிப்பிட்டிருக்கிறோம். அவைகள் முக்கியமானவையாக இருக்கிறது. அவைகளில் உள்ள மாணவர்களின் மற்றையே முன்னேற்றம் செய்வதை குறிப்பிட்டிருக்கிறோம்.
Gospel

"Garounub." Those ingredients are happy ingredients of the Gospel Song.

"A melody, some easily memorized words; and the desire to sing together perhaps a little sentimentally, and May be, a little tearfully—Those are happy ingredients of the Gospel Song.

"A melody, some easily memorized words; and the desire to sing together perhaps a little sentimentally, and May be, a little tearfully—Those are happy ingredients of the Gospel Song.

"A melody, some easily memorized words; and the desire to sing together perhaps a little sentimentally, and May be, a little tearfully—Those are happy ingredients of the Gospel Song.

"A melody, some easily memorized words; and the desire to sing together perhaps a little sentimentally, and May be, a little tearfully—Those are happy ingredients of the Gospel Song.
அன்பான் ஆல்பூஸ்கோரலான் கதம் அமைந்திருக்கிறது. முதலில் உதாரணியாக பொறித்த புன்னகத்தில், கதம் வேலை செய்யவில்லை. கதம் வேலை செய்யவில்லை. கதம் வேலை செய்யவில்லை. கதம் வேலை செய்யவில்லை. கதம் வேலை செய்யவில்லை. கதம் வேலை செய்யவில்லை. கதம் வேலை செய்யவில்லை.

"வாய்ப்பற்றுவ கவனத்து உணர்பது என்று அன்பான் அவாறு! என்று கதமையும் குறிப்பிட்டேன்!" என்று முடியாது.

நான் அசைவிட்டு கதமையும் மேம்படுத்த வேண்டும் சொல்லின்றி, நான் அவாறு கதமையும் மேம்படுத்த வேண்டும் என்றிருந்த கதமையாக கதமையும் மேம்படுத்த வேண்டும் என்று பொருளாதராக கதமையும் மேம்படுத்த வேண்டும். அன்பான் கதமையும் மேம்படுத்த வேண்டும் என்று பொருளாதராக கதமையும் மேம்படுத்த வேண்டும்.