THE SOLAR PHYSICS OBSERVATORY, KODAIKANAL.

Time and season have always been the preoccupation with man. Man from the ancient days has always cast a wistful glance at the sky either because he was overcome by the mystery it had for him which he feared was meaningful for his existence or he was simply amazed by the wonder of it all. 'Hitch one's wagon to a star' or in the words of the poet, 'The fault is not Dear Brutus, in our stars, but in ourselves' imply a belief as seen in the interest in Astrology that there was a divine government of the world. In their early gropings they may have also apprehended that the phenomena in the heavens influenced man's life and happiness. It was also known that the fertility of the soil depended upon the Sun shining in the sky and the occurrence of seasonal rains and that storms and the rages of the elements also caused catastrophies. The French Revolution, some believe, was partly due to a famine as a result of the expected rains which never came.

Astronomy - or the Science of the celestial bodies, was known to the ancients. From the record of orders promulgated by Emperor Yao of the third milenium B.C., it is known that equinoxes and solstices were determined in China by culminating stars.

Astrology as a prelude to astronomy played an important part in the religion of the Egyptians, for it is known that the heavenly bodies were observed for purposes of worshipping them. Babylonian Astronomy took a clear leap later as seen from records dating 3800 B.C. and it was here in Babylon, true astronomy emerged as of vital importance to civil life. The Arabs, who were used to watching the desert skies, were also interested in Astronomy.

Thus man's life on this planet, as the development of astronomy indicates, is virtually a hitching his wagon to the starry sky. The study of the sun and the stars in their courses as well as the modern research on their composition, qualities, etc., have been found to be most invaluable, for human existence on earth. National

observatories such as the Kodaikanal Observatory are of vital national importance in as much as they step up the physical knowledge of the celestial bodies, so important for the national well-being in its various aspects.

An iron meteorite weighing 35 lbs., the second to be found in India, it is said, was dug at Kodai a few years before the turn of the century. It is now housed in the Calcutta museum. Did this forecast the removal of the solar and meteorological observatory from Madras to Kodai? After an existence for over a hundred years at Madras, it has now come to stay on the highest point in the immediate neighbourhood of Kodai where its field of research to-day has considerably exceeded its original scope. The Government astronomer at this observatory on 16th May 1910 observed the Halley's comet whose light, it is believed, extended from the horizon to mid-heaven.

Its life in its new abode dates from 1899. Although it is not the world's largest observatory, such as the one on Mount Wilson, it is much older. This observatory is no longer confined to solar and stellar work but has branched off into many other fields of research in Astro-physics. It has a record of active and useful participation in significant observatory expeditions on an international scale. This year - is the Geophysical Year. And once again the Kodaikanal Observatory will be taking part during the months of August-September along with the observatories in other parts of the world. This will be work of some significance to beundertaken by the meteorological department of the Government of India.

Here is Mr. Das, the Deputy Director-General of Observatories. Greetings to you, Sir.

Would you be so good as to tell me something about the most fascinating and interesting place of yours? First of all, Mr. Das, do tell me please how this came to be here, in an outline story of this observatory.

Mr. Das: This observatory really had its beginning in Madras where it was started, as an observatory for observing the movements of celestial bodies, what we call the astronomy of position, by the East India Company, and during its existence in Madras for nearly a century, it did excellent work in this particular field. In about 1875, there was a famine, the great famine of India which was caused due to the failure of the monsoon and naturally there was a lot of criticism of the Meteorological Department and it was asked why the meteorologists could not forecast the failure of the monsoon. It so happens that meteorologists even to-day know not all that one ought to know about the atmosphere of the earth; and in those days, they naturally knew much less and it was thought by some scientists at least that one might get very useful information about the mechanism of weather if one could study the sun itself which after all is known to be the ultimate cause of every terrestrial phenomenon. So they thought that it would be very good to start a Solar Physics Observatory somewhere in India which might help the forecasting of monsoon.

Then the question was what sort of place is required for the Solar Physics Observatory;and the conditions required for a Solar Physics Observatory are very different from what one wants for an ordinary astronomical observatory.

Mr. Theodore: Sorry to interrupt Mr. Das, do you mean to say the conditions in Madras were found to be unsuitable or unfavourable.

D: Well, at that time, there was no solar physics strictly speaking; but they were satisfied with what they were doing in astronomy of position but when they began to think in terms of solar physics, they had to think also of a place because Madras was not thought to be so good for solar physics work. In fact, it is well-known now that you want a place with a good altitude, you want a place where the atmosphere is free from dust as far as possible, you want a place where the number of days of observation in a year is large and things like that. So after a lot of

surveying, it was decided that Kodaikanal is a very possible place and about 1896, I think, they began constructing the buildings at Kodaikanal. At that time, the Director, rather the Government Astronomer, as he was called in Madras, came here and took his residence and began the buildings.

T: Apart from the altitude, Mr. Das, I suppose, the deciding factor was also the number of days, clear days, I mean, when you could make observation. Wasn't it so?

D: It was also a very very important consideration.

T: So considering that, on an average, could you tell me how many days you are able to.....

D: Well, from our records, since 1898, when the observatory began to function here till date, one might easily say that we get on an average about 300 days a year.

T: That is a good record.

D: Exceptionally good record. There were of course, when I say, an average of 300, sometime we have had 310, sometimes 290, but it can go upto 310 and that I think is very unique. There is only one other observatory, that I have heard of, can claim to have so many days of observation in a year and that is Mt.Wilson.

T: So, in India, practically, Kodaikanal stands unique in that position - at the moment.

D: At the moment, I would say that we have not been able to find any other place better or equal to it although we have made several expeditions in the Himalayas and things like that. We have not found anything equal to Kodaikanal yet.

T: Before we go into the mysteries of the place, Mr. Das, can I ask you a question? I believe the International Geophysical Year commences sometime this year, am I right? What does it mean, Mr. Das, the International Geophysical Year?

D: Well, it is really a programme of intensive observation of

meteorological phenomena, meteorological factors as well as allied things, like solar physics, geomagnetism, seismology and very many things like that. Now in old days, they have already had two more, such geophysical years, ~~xxxx~~ although in those days they did not call them geo-physical years, they used to call them Polar Years; two had already been done; but this time, it is called the International Geophysical Year to make it more specific because it deals with not simply the polar regions of the earth but the whole earth. Now during this geophysical year, which will start next year in July and go on till the end of 1958, it is not really a year, a year and a half...

T: Yes, but for the sake of terminology, I suppose...

D: Yes, and ~~during~~ this time, intensive observations of every kind will be made. This observatory will be responsible for a good part of the work which our country will do. We belong, as you know, to the India Meteorological Department. The India Meteorological Department will naturally do most of the work and we being the only observatory dealing with solar physics, naturally we have a great share in this work. We will be studying the sun very intensively. All our hours of observation have increased. Already, we are doing this sort of...

T: Preliminary observations...

D: Preliminary preparations and we are observing the sun more frequently. We will observe other things like the ionosphere more often, and geomagnetism - also one of our items in that; in fact, everything to do with solar physics and connected subjects will be done here, even cosmic rays.

T: In connection with that, Mr. Das, since it is called the International Geophysical Year, does it mean that specific work will be allotted to each observatory on an international level for each to make a contribution of a special study of a particular subject?

D: This item, it has been arranged internationally. In India, we have the Indian National Committee for the geophysical year; every country has a National Committee. These National Committees,

in consultation with the International Committee, prepare the programme of what the international organisation want that everybody should do. Whatever they can they do and all these things are pooled together ultimately.

T: If I may ask you, what is the specific work that has been allotted to you this year?

D: We have been allotted everything to do with solar physics, and as I said, geomagnetism and ionospheric studies, cosmic rays, the study of the ozone in the earth's atmosphere.

T: A big chunk of work.

D: All these things we have been given.

T: Also another interesting piece of information, if you can give me, would the observations you will be making during this period also concern with the satellites, about which so much is talked about these days? I believe they are going to release some next year. Isn't it?

D: Yes, they are. They are going to release, they are going to launch the satellites which will go round the earth. But whether we shall be able to observe them at Kodaikanal, I am not sure because we have not got the tracks of these satellites. We have to get these yet. There has been some correspondence about this and as soon as we get the information, we will naturally be interested to study this also; but it may just turn out that we may not be able to observe the satellites from Kodaikanal itself. It is possible also, I do not know, that depends upon the track; but if it happens to be somewhere else in India, most likely the India Meteorological Department, naturally with the assistance of the Kodaikanal Observatory, which is the organisation for astronomy of India and also of our department, will help and go somewhere else where we can observe ~~in India~~ with telescopes and things ~~like that~~. like that.

T: There will be some expeditions arranged for the purpose.

D: It will be in India but I think it may be some other place, not Kodaikanal. It ~~may also be~~ possible that we may be able to observe ~~it at~~ Kodaikanal.

T: So, the release of these satellites is vitally concerned with geophysical year.

D: Because these satellites will carry instruments of all kinds for observing the atmosphere of the earth at very high levels and they will carry also instruments which will record cosmic rays, which are not in the earth's atmosphere at all. They come from outside but even that will be studied by the instruments carried by the satellites. The satellites will carry a very large variety of instruments. So, many things connected with the geophysical year will be done even by the satellites.

T: Mr.Das, just now you said something about ozone in the atmosphere and some work which this observatory is doing in connection with that. Could you tell me as a laymen would understand what thatmeans?

D: Yes, you know in the earth's atmosphere at the height of some 20 kilometres to 50 kilometres roughly, there is a layer which contains ozone which is formed by the effect of ultraviolet sunlight on the oxygen present in the atmosphere and this layer is usually called the ozone layer. Now this layer has a good deal of influence on the earth's atmosphere and on the observation of stars; for example, certain kinds of observation cannot be done beyond a certain wavelength in the spectrum of stars because ozone cuts off everything beyond that. So astronomical spectra are limited to a certain range in the short-wave side; — beyond that, you cannot observe the spectrum because of the ozone. Now this ozone canbe studied by a certain instrument which is known as the ozone-spectrophotometer, the particular one which has been devised by Prof.Dobson of Oxford. We have recently acquired one of these and this is planned to measure ozone regularly during the International Geophysical Year.

T: How does it affect human existence, as you say?

D: It affects in a very peculiar way. The sun emits very strong ultraviolet rays. Now if the ozone layer in the earth's atmosphere did not exist, there would be nothing practically to absorb the ultraviolet light from the sun and this ultraviolet light is extremely injurious to human life and other kinds of life too.

T: Oh, I see.

D: Everything will be burnt up. So the study of the ozone layer is vitally important to life...

T: From the point of view of...

D: Human and life in general on earth.

T: Yes. That is most interesting. So, you say the actual work has commenced in that line. Isn't it?

D: I cannot say we have commenced it.

T: You have got the instruments now?

D: We have got the instrument, we will begin shortly. But this kind of work has already been done by other observatories. In Delhi, they are already doint it and the Ahmedabad Laboratory, — Physical Research Laboratory, — they are doing it at Mt.Abu and we will be one of them but we will start very shortly.

T: Excuse me going back to the subject. I am going to ask you elementary questions, Mr.Das. As a layman, I would like to know what you mean by astrophysics, as different from astronomy and so on. Could you tell me?

D: Well, astronomy ordinarily used to mean the study of the positions of the astronomical bodies, the celestial bodies, but to-day, astronomy really means also astrophysics. It not only means the study of the positions of the astronomical bodies but also the constitution of stellar bodies and the sun, the planets and all that. Now, that part of astronomy which studies the physical side of astronomy, i.e. the constitution of the stars, the planets, the sun, is called astrophysics.

T: Oh, yes.

D: Therefore, astrophysics in a wider sense is a part of astronomy.

T: Oh, yes.

D: You mentioned in your introductory talk.....

T: Yes.

D: about this Solar Physics Observatory at Kodaikanal. Well, that is how it started in old days, it was called Solar Physics Observatory; but I feel that it is no longer right to call it Solar Physics Observatory because it has various other lines of

work now; it should be called properly Astrophysical Observatory.

T: Oh, is that so?

D: In the wider sense. It is certainly working in solar physics also.

T: They are now going to give another name, I noticed the other day, Mr. Das.

D: That is what I have heard. It is all in the paper.

T: Officially?

D: Officially or unofficially, I don't know.

T: There are so many important lines of work this observatory is doing. You mentioned a few, could you take me round and tell me what are these important instruments, Mr.Das? You said spectrohelioscope, spectroheliographs and so on.

D: Well, I will just give you a rough idea about the organisation of the observatory first. That will probably help tounderstand things. Well, we have the Solar Physics Section. Then we have the Stellar Physics Section. We have the Ionospheric and Magnetic Section. We have got also a Radio Astronomy Section.

T: Is that so, which deals with radio waves and so on...

D: Radio waves from the stars.

T: and how it affects radio diffusion and so on? Incidentally I suppose your data will be helpful.

D: Yes. Now,in the solar section, we have various kinds of instruments, the spectroheliograph which you mentioned, that is one of our principal instruments in the solar section. Its main function is to take photographs of the sun in monochromatic light, one particular wavelength which you may choose at will; usually, we choose the red line of hydrogen and we choose also the violet line of the ionised calcium atom both of which are present in the sun. With this instrument, we can take photographs of different levels in the sun's atmosphere. When we take aphotograph with the calcium line, 'K' line, as we call it, we get the distribution of the calcium atoms at a particular level in the sun's atmosphere. When you take a photograph with the hydrogen alpha-line, as we call it,

we get the distribution of the calcium atoms at a particular level in the sun's atmosphere. When you take a photograph with the hydrogen alpha-line,as we call it, it represents the distribution of hydrogen atoms at a certain level in the sun's atmosphere. Now this is really what we are finding out in the sun's atmosphere.

T: Oh, is that so!

D: In the case of meteorology,for example, they send up balloons and then they can study the winds and things like that. But on the sun, such a thing is impossible. All that we have got to hang on to is the radiation that comes from the sun. So by study'ng the radiation and using particular wavelengths of light, it is possible to do very similar work, to study how the particular level in the sun's atmosphere is constituted. That is the function of the spectroheliograph.

T: Any other special apparatus thatyour observatory possesses?

D: Practically, every instrument is special.

T: Is that so?

D: Yes. We have got a spectrohelioscope, for example, which does not photograph but which can keep a continuous watch on what is happening on the sun and you know exactly when the sunspot appears. You know how it is changing, you know if there is a particular region near the sunspot which suddenly flares up and emits a lot of extra radiation, emits a lot of particles, which, of course, would interest you because this will affect the radio communication on the earth. The spectrohelioscope is on constant watch throughout the day and whenever the spectrohelioscope observes something unusual, the observer reports to the spectroheliograph observer and the spectroheliograph, as I told you, ~~does~~ photographs. Naturally, it costs a lot of money to take so many photographs. So visually, we keep a continuous watch, and the information about any new phenomenon or interesting phenomenon that is observed is immediately communicated to the

spectroheliograph observer and he takes photographs. Sometimes, we take photographs from early morning till late in the evening, till the sun goes down.

T: I was going to ask you what are the times and hours you observe for making the observations?

D: We begin solar work athalf past 7,but some of the work, the ionospheric work, goes on all the time. There is no stop.

T: There are people all the time, 24 hours ?

D: Yes, 24 hours; but solar work begins at half past 7 and goes on till 4 O'clock normally, but if there is anything unusual happening on the sun, then there is no time, observation will go on till the sun goes down and very often when there is anunusual phenomenon, photographs are taken at half-minute intervals, throughout the day.

T: Is that so? What I see installed outside is the telescope which you see?

D: The one which you see in front of the building? That is not for that. It is a telescope for photographing the sun in ordinary light. There is no monochromatic arrangement there and you can photograph the sunspots. We are trying out a particular instrument for a special purpose; wehave got a regular instrument which is called the photoheliograph which is in one of the two domes you see. It is the same thing as the one we are ~~x~~ trying to instal now. It photographs the sunspot positions and how they are changing from day to day.

T: It may be of interest to hear from you as to whether this observatory has beenable to observe some very important stars or constellations.

D: As I told you, the observatory has so far been specialising in solar physics. We are now beginning work in stellar physics; so I cannot say that we have made any special observations of any new stars. But we will be doing so in due course. Several new discoveries have been made in this observatory. Particularly, I may mention the work of Mr.Evershed, who was the second Director of this observatory

T: Oh, is that so?

D: He did some very important observation which is called the 'Evershed Effect'.

T: Is that so?

D: It has a great deal of importance in astrophysics in general. His name is connected with that. It will go on.

T: Oh, is that so?

D: That is one. Then another Director who followed Mr.Evershed, he did a very interesting discovery, that is the existence of oxygen in the sun's atmosphere, that is free oxygen.

T: Yes.

D: Yes.

T: For they are important and there is something with which this observatory is associated, and therefore what they have been able to discover is associated withthis observatory.

D: And there are of course many other things which other Directors also have done.

T: Mr. Das, you wanted to say something about the stellar physics, could you tell me some, please?

D: Yes, I mentioned that in the old days this observatory specialised in solar physics. But now we are developing in the direction of stellar physics also. We have already got a decent-sized telescope, we cannot call it a big telescope in comparison with the telescopes of America; but it is a good telescope, fairly good, fairly big size, what we call the Bhavnagar Telescope; this telescope has ~~got~~ a history. It originally belonged to the observatory known as the Takhtasinghji Observatory ~~at~~ Poona. It was in existence in Poona probably till 1905-6 and then the observatory was closed down for some reason or other, and this telescope was given to the Kodaikanal Observatory.

T: As a gift?

D: As a gift to the Government of India and the Government of India naturally sent it to the Kodaikanal Observatory. ~~The~~ .

This telescope has been recently installed, about 3 years ago, and we have begun a certain amount of work in stellar physics. We are studying the spectra of planets and some stars; but one interesting thing we have already done in international co-operation with this telescope; that was the year before last; there was a programme initiated by the Lowell Observatory of America for studying Mars when Mars came very near to the earth.

T: Yes.

D: Mars came very near and we were one of the eighteen observatories which co-operated; and Mars is again coming very near to the earth this year.

T: Really?

D: And during September, I think it is September the tenth, is the date of 'opposition', as we call it. Then we are going to start proper observations of Mars again, but we are beginning very soon just as a preliminary trial; they will go right through the opposition till the end of October.

T: That is very interesting.

D: That is one of our international co-operations.

T: Yes.

D: in recent times.

T: Yes. So it is really most fascinating to hear these interesting things from you, Mr. Das. That surely makes out a case for star-gazers; for there are more things in heaven I see now than are commonly thought of by the ordinary layman. Thank you very much. Good day.
