have the fullest possible support from the members and Council, and that the Society will have a successful session during his tenure of the office.

PRESIDENTIAL ADDRESS.

GENTLEMEN,

I beg to thank you for the honour, you have done me in electing me to the Presidentship of the Astronomical Society of India. It is no language of mere convention, when I say that I have responded to your invitation, with considerable diffidence; for while I have to succeed one who is devoted to Astronomical research with a singleness aim, I shall have to work without the wise guidence of your founder, Mr. Tomkins, who, whether as President or only a Senior member of the Commitee was always ready to be at the helm, whenever the needs of the Society demanded it.

The most noticeable-at, the same time the most regrettable incident, in fact, of the last Session, so far as the Astronomical Society of India is concerned, was the departure of Mr. Tomkins for England, on sick leave-let us hope, only for a time. You are well aware, how enthusiastic a student of Astronomy, and how devoted a worker in the cause of the Astronomical Society, Mr. Tomkins has been and I feel sure you will all join with me in fervently wishing him a speedy recovery and return to the scenes of his labours. We can, indeed, ill afford to do without his advice and assistance, at this stage, when the Astronomical Society of India, along with other Scientific Societies, all over the World will be called upon to put forth their best energies, not only to make up for lost time but, also, to take advantage of the great forces for good, that have been ushered in, with the conclusion of peace.

That reminds me that we succeeded in securing the services of our last President, through the accidents of the War-conditions and we have now lost him also, because those conditions no longer operate; so that, much as we regret his resignation of the Presidentship, on our own account, we have

reasons to congratu'ate ourselves, in that Dr. Royds will now be able to dovote himself to those researches, which will be to the lasting benefit of Astronomical Science. We have, indeed in this country had to regret, comparatively, minor dislocations only, so that the ravages of the great European War have not been with us, by any means a familiar experience. In Europe, on the other hand, confining ourselves to Astronomical matters only, it was associated with a veritable cataclysm. In Belgium, especially, the tale is a woeful one. The annals of the Royal Observatory of Belgium for 1916, 17, 18 have only recently been issued: In the preface to the 1916-volume,the Astronmer in charge writes :—

"This number was published in 1916 without the knowledge of the power then in occupation, but it was not possible to publish it, before now (1918), as it then would have had to be submitted to the Censor, appointed by our Oppressors."

In the number for 1917, which is a very small volume, by the way, it is stated that "since the commencement of hostilities,a large number of publications never reached us, so that it has not been possible to give a complete account of the progress of Astronomy since 1914."

In the Nautical Almanac, for 1919, a small reference incidentally made gives also a slight indication of the war position of Astronomy.

These comparatively small items give one some idea of the devastating effects of the War, which is now happily over. This War indeed, with its especial circumstances of horror, constituted the negation of all Science, nay of civilization itself. For, although Scientific activities of a certain type were not altogether at a stand-still,in fact, in some respects, they were very much in evidence, it is clear that, when every active member of practically all the most Scientific races of the World was preoccupied, the output would nocessarily be limited in quality as well as in quantity. An insight into this pre-occupation is afforded by the following extract from the preface to a monograph by Dr, A.N. Whitehead "on an enquiry concerning the principles of Natural Knowledge" which I am tempted

to quote, as giving a vivid presentment of the situation. He says:

"Memories are short and perhaps, it is not inapt to put on record, circumstances common to the life of all England, during the years of War. The book is the product of intervals of leisure, amid pressing occupation, a refuge from immediate fact. It has been thought out and written amid the sounds of guns—guns of Kitchener's Army training on Salisbury plains, guns on the Somme, faintly echoing accross Sussex Coast; some few parts, composed to pass times of expectation, during air raids over London, punctuated by the sound of bombs and the answer of artillery, with the argument clipped from the whirr of aeroplanes. And through the land anxiety and at last the anguish, which is the price of victorys'-referring, apparently, in particular, to the death of Eric Alfred Whitehead of the Royal Flying Corps at the age of 18, to whom the book is dedicated.

It is unnecessary here to develop the full significance of all that the above extract attempts to indicate or discuss the benificient ends to which they will ultimately lead. The race for the exploitation of the weaker by the stronger, of which the World was the scene,before the war,was bound to cease and a re-adjustment of relations to ensue, through a mighty upheaval if need be, such as we have witnessed. The principle of this re-adjustment is to be co-operation, throughout the manifold complexities of races, communities and nations. My object here is only to emphasize that Astronomical study and research like every other form of human activity will presently acquire new vigour through a new appreciation of this principle.

In the case of Astronomy, indeed, this World-wide co-opertation is especially essential. For its survey extends over the universe itself. Take the case of the photographic chart of the Heavens. The work had been begun in isolated observatories, chiefly in France but it was soon apparent that it could only be completed by international co-operation. And a project was accordingly set on foot by the Astrographic Coference of 1887, for a complete map of the whole sky, on

this basis, of which Sir David Gill of the Cape Observatory and the late Admiral Mouchez were the moving spirits And the details of this project bring out the stupendous nature of the undertaking :

There are 45000 plates to be taken, half of which are to have a long exposure of nearly an hour, showing on the average 1000 stars, per plate ; the other half, a short exposure giving only the brighter stars, about 300 per plate, so that the international chart, when completed will be ten times, as accurate, as the most accurate chart extant.

Another Astronomical work, on which international co-operation is essential is the observation of the Total Eclipse of the sun. It is easily seen that an observer can only see a total Eclipse of the Sun, if he is situated in the cone touching the Moon and the Sun at the same time. The Eclipse has therefore to be observed from regions of the Earth lying on this Cone, so long as there is such a region. It is a somewhat narrow belt of the Earth, traced out, on account of the motions of the Earth and the moon and passing often through places which are not by any means conveniently situated. In view of this and in view of the fact that the duration of totality is extremely limited, a multitude of expeditions, and a multitude of observers is necessary and all this can only be secured through international co-operation and mutual good-will. Of the many questions that will find their answer from observations at a total eclipse, it is unnecessary to speak here. I need only refer to the remarkable confirmation of the theory of relativity which the last total eclipse has supplied, a fact which has been recently announced in the papers, under sensational head-lines.

As a further illustration of work, on which this co-operation is of the highest importance, we may cite the observations of the Comets, Meteors and Novae,—all those celestial bodies, namely, which are rare visitants to the regions that are within our purview. It is unnecessary to labour the point that it is only by observations, undertaken by numerous observers but sufficiently careful and scientific that we shall

ultimately succeed in deciphering their true nature and it is worthy of note that, after all, it is very little indeed, that is certainly known with regard to them.

The manifoldness, in fact, with which, modern Astronomy deals, can only be deciphered, so far as is, humanly speaking, possible, on the principle of World-wide co-operation alone to which I have already referred, and which is also the fundamental canon of Astronomical research. Our planes of reference are absolutely extra-terrestrial, the celestial meridian through the first point of Aries and the ecliptic, even as a first approximiation, our origin of reference, in the general case, is the Sun's centre, our initial epoch is a matter of Astronomical practice, only and even our units are chosen, so that they may be independent of local conventions. In view of this and the infinite variety and complexity of the phenomena that present themselves, there is room for every worker.

Of the vast majority of these, we with our limited powers can never have any direct knowledge. Thus, taking the case of our nearest neighbour, the Moon, if by increasing the magnifying power of our telescopes, we could bring it sufficientiy near, the image would lose in definition, on account of decreased illumination, almost beyond recognition, so that there is a limit to visibility of celestial bodies,with the appliances at present at our disposal. Yet, although we can have no direct knowledge even of the moon, we have a remarkable body of indirect informations, for which we are indebted to methods of Scientific Research, that it will not be unprofitable for us to analyse briefly.

The motions of heavenly bodies, being all apparent, mere observations, however carefully conducted, could not tell us anything about their motions, till these are *computed*, on this postulate of apparent motion. It is on account of an incorrect appreciation of this condition, that for thousands of years, Astronomical Observations lacked cohesion and the laws of these motions were lost to view. Thus, the method of *computation*, even in the tentative form in which it was used by Kepler produced a real transformation and we now

have a fairly complete knowledge of the motion of the solar system. This has been attained. through successive stages ; Kepler's laws being shown by Newton to be consequences of the principle of universal gravitation and Newton's method again having in recent years undergone complete modification in the hands of G.W. Hill and his School. And now. Newton's theory itself is being *recast* on the modern principle of relativity. And not merely, in the matter of the motion of the Solar system but also that of a large number of stars, (single and binary) and of nebulae, our knowledge is wonderfully precise, regard being had to the minuteness of the pheno nena involved.

But the method of computation is confined to a comparatively narrow field. For further information and a wider outlook, we have to resort to the method of *comparison*. Here, the chief instrument of research is the spectroscope and it is of immense interest to note that we are able, through its means,to decipher the nature of s'ars and nebulae, classify them and obtain an idea of their history as well as a wealth of information, regarding the constitution of the sun and its atmosphere. Since incandescent gases give bright-line spectra and white light passing through gases at a lower temperature give rise to continuous spectra, interspersed with dark lines, the character of nebu'ae which as a rule yield spectra of the former kind, on the one hand and those of the sun and stars, which yield spectra of the latter kind stand revealed. And the complexity of these various kinds of spectra correspond to the complexity of the problems presented by the constitution, physical and chemical of the sun and stars and the atmospheres, associated with them. The method of comparison is here naturally at a disadvantage, in that the conditions, as regards temperature and pressure that obtain in the sun,the stars or the nebulae cannot be reproduced in the laboratory and we have, accordingly, vast, as yet unexplored fields which can only be investigated by methods which are as yet in their infancy. The exact nature and origin of Sunspots, for instance, which have been investigated

for a long time still baffle analysis. Hence, to suggest that they are due to or are, in any way, affected by the attractions of the planets is wholly unwarranted by the present state of our knowledge, regarding them. They are, evidently, of the same order of phenomena as vulcanic irruptions, and if so, the steady action of the planets can have but little effect on them, specially, as the maximum effect that can thus be excited is infinitely small, compared with that of the sun itself. And as to the metereological effects of the sunspots, it will be unsafe to assert, with certainty, that they can be at all of a prominent nature.

From what I have stated, it will readily appear that these methods are of a limited scope. They, however, aid each other and are aided by the method of *hypothesis*, which used with care, is a powerful instrument of research. It is unnecessary here, to discuss the general scientific value of hypothesis. I would rather confine myself to a brief reference to the most celebrated hypothesis in Astronomy—the *nebular hypothesis*, which illustrates, in a remarkable manner the limit and scope of such a hypothesis.

As stated by Laplace, the solar system was originally a hot nebulous mass or gas which was supposed to rotate and cool at the same time. This would have the effect of decreasing the size and increasing the angular velocity on the principle of angular momentum. When the rotation increased, beyond a certain amount, a ring-shaped mass was supposed to be thrown off from the equatorial region. These rings were supposed finally to agglomerate into planets and to give up statellites in their turn.

This result may be tested by the method of computation and that of comparision. Mathematical calculation has shown, however, that a rotating liquid or matter of high density will break up into binaries and triplets, while a rotating mass of gas of extreme tenuity will assume gradually a lenticular shape and give up, not rings but filaments at the two extreme points of the lense, which will break up into nucleii, regularly spaced out.

The hypothesis seems, thus, capable of explaining the formation of binary and triple stars as well as spiral nebulae giving up star clusters. Whether it is capable of explaining the solar system,also,cannot, as yet, be stated for certain, for a gas under its mutual gravitation cannot be homogeneous but the corresponding mathematical problem still awaits solution. Although, however, the nebular hypothesis, so far is a hypothesis merely, it cannot be said to have proved infructuous, in as much as it has forcibly drawn attention to the manner, in which the myriads of heavenly bodies may have come into existence—to a certain unity in the midst of the wonderful diversity that subsists in the universe,

These methods of research, however, which naturally appeal, as a rule, only to the professed Astronomer, equipped with special appliances are all based on observations, carefully and methodically carried out. In this, every one interested in Astronomy can take part. Elaborate appliances, refined mathematical analyses and bold hypotheses, (which are really inspirations of genius) are necessary, only for higher developments of the Science. But even great and important discoveries are open to the earnest observer,pursuing his inquiries with patience and diligence. Tycho Brahe indeed, had but few apparatus and even in our day, Chandra Sekhar Sinha Samanta, who has been called a modern Tycho achieved wonders, with appliances which were much less perfect than those of Tycho himself. Such success, however, can attend, only the labours of the few. For the many, the fascinating study of Astronomy must be its own reward. If, to this may be added a contribution, however small to the stock of knowledge, it will be an added satisfaction, I trust, in years to come, there will be all these classes of workers, among the members of the Astronomical Society of India.