Extracts from Publications.

Protection of high observatories from lightning.—In a recent number of the "Comptes Rendus," J. Vallot gave an account of a number of cases where observatories at high elevations have been struck by lightning within the last few years, with much damage to apparatus, and danger to the observers. In one case it was a wooden observatory sunk into the snow, and unprovided with lightning conductors. But even observatories provided with them have not been spared. A good earthing is difficult, as snow and frozen soil conduct badly. In an observatory erected on snow, cables were laid to the bare rock 100 yards away to provide an earthing. But evidently the long cables were not able to conduct away the large quantity of electricity passing in the lightning.

The *Observatoire des Bosses, on Mont Blanc*, has, on the other hand, never been struck by lightning. In this case the protective device is the following: Four lightning conductors with several points each are erected on the roof and mutually connected. Each is also connected with the rock by means of an iron wire ½ cm. thick, ending in a coil. The whole observatory is covered with thin copper plates, connected to the lightning conductors, and to the stove-pipe. The whole arrangement constitutes a Faraday cage, and has effectively protected the observatory for thirteen years, the lightning always finding ample conductivities to render it innocuous.

An efficient protective device for observatories built on deep snow has, however, yet to be devised.

[*English Mechanic.*

Visual Observations of Red Variable Stars. (*By J. A. Parkhurst*).—Inquiries from several members of the Variable Star Section lead one to mention again some points in regard to the observations of these troublesome stars. These points have appeared before in "Popular Astronomy," but they will bear repeating.

(1) Punch's famous advice to those about to marry—"Don't" will apply very well to observers of very red stars, until they have accumulated a considerable experience with the easier, less highly coloured stars. But, assuming that difficulties will not deter the industrious and courageous members of the section, the following suggestions are offered.

(2) If a white and a red star appear equally bright in a certain field, they will change their relative brightness with change of conditions as regards (*a*) aperture used, (*b*) altitude, (*c*) haze or moonlight, (*d*) personality of observers, (*e*) duration of steady gaze, (*f*) angle between the line joining the stars and that joining the eyes (this last change will be apt to affect stars of any colour). Taking the points in order—

(*a*) An increase in aperture, giving more light, will make the red stars appear relatively brighter. A decrease will have the contrary effect.

(*b*) Change in altitude will have a complicated effect. For example, a decrease in altitude would make the red star lose in brightness on account of greater general absorption, but this might be more than balanced by the less amount of selective absorption for the red rays.

(*c*) It is hard to predict the direction of the effect of haze and moonlight, but they should be avoided.

(*d*) Eyes vary greatly in their sensibility to red rays, differences exceeding half a magnitude being not uncommon.

(*e*) Gazing steadily at a red star, it will usually appear to increase in brightness for some seconds. A good rule would be to gaze steadily till this increase ceases before making the estimate.

(*f*) The line joining the stars to be compared should be parallel to the line of the eyes. If two stars appear equal in this position, then if the head be rotated 90° the lower star will appear to most eyes about half a magnitude brighter, though to some observers there is little or no change.

If the precautions under (*a*), (*b*), (*c*), (*e*) and (*f*) are followed, some experience will enable the observer to get a consistent curve for his own eye; but on account of (*d*), his curve will not necessarily bear any definite relation to that found by another observer. Therefore it is not advisable to form a composite curve for the work of different observers, until the relation between their personalities has been determined. These considerations have led the writer to prefer photographic methods since a proper choice of plates and colour-filters will give both photographic and "visual" magnitudes free from the above difficulties except (*b*). A statement of the magnitude of a red star, as observed with the eye,

is not complete unless the conditions mentioned under (*a*), (*b*), (*c*), (*d*) and (*e*) are specified; and no longer holds if any one of the conditions is changed.

Yerkes Observatory, March 1912.

[*Popular Astronomy.*

A Question on the Capture Theory. (*By N. W. Mumford*). —Below may be found a very brief summary of Prof. See's monumental quarto volume on Cosmogony, concluding with an apparent exception to his theory.

The matters of greatest interest brought forward in the volume are; the theory of a general prevalence of a resisting medium in space, the assumption of the existence of such a medium in the typical or spiral nebulæ, and the tracing of the evolution of the solar system from a nebula of that class.

The author undertakes to show how the innumerable points of condensation in the vast nebular coils must revolve about the central nucleus, gradually uniting with each other under the force of gravity, and producing comparatively small globes or planets, whose orbits are reduced in size and rounded under the secular effects of the resisting nebulous medium. In the solar system this process is said to have practically cleared the interplanetary spaces of nebulous matter and to have evolved a highly stable cosmical figure, but doubtless one very far from unique among the millions of single suns. Among the smaller masses in the original nebula certain proportion would be captured by the bodies of planetary size and permanently held, owing to the force and the effects of the resisting medium. All moons captured in this way would not necessarily revolve about their primaries in the same direction. The prevailing rain of meteorites and cosmic dust during the clearing up process would produce planetary rotation in one direction. Other so-called moons, not captured by the planets, take up regular planetary orbits, becoming asteroids, and still other bodies, visitors from the region of the outer shell of the original nebula describe nearly parabolic orbits (except when such orbits are transformed by the action of large planets) approaching the central luminary at long intervals, and appearing as comets.

The stars themselves would appear to be condensations of nebulosity, adding to their own bulk by accretions of enormous amounts of waste matter attending them, and often

appearing as double, triple and multiple suns, when two or more dominating centres of condensation sweep up the nebular strays and settle into orbits about their common centre of gravity. The variable stars would seem to be those pairs whose plane of revolution lies in line with one sun, and whose orbital movements, when the plane is thus situated, would produce eclipses; or else pairs revolving in long ellipses, about a common centre, that appear to encounter considerable resisting medium on close approach, causing them to flare up or fluctuate in brightness. New or temporary stars would seem to be those produced by collision between a planet, a satellite, or large comet and its central sun, causing a sudden conflagration; or one of the dark bodies of planetary size wandering in space, might enter a small nebula, the result being the blazing forth of a new star. The author regards the collision between sun and sun as a possibility so excessively remote that by the law of chances it practically never occurs.

The clusters of stars would appear to be the result of many condensations in nebulæ of extraordinary extent, whose combined power of gravitation may attract neighbouring suns into the mass; and the more diffuse star clouds seem to be gathered in somewhat the same way, but without regularity of form or condensation towards a common centre. The galaxy would appear to be the grand aggregate of nearly all the star clouds and clusters, spanning the heavens as an arch or girdle that embraces the visible universe. This stratum of stars is supposed to extend outward in its plane indefinitely. The existence of the coal sacks receives no satisfactory explanation.

The maintenance of the balance in the making and unmaking of the suns is thus described:—"On the one hand, nebulosity in the finest known state is expelled from the stars and drifts hither and thither through the universe, till it collects into cosmical clouds or nebulæ; on the other hand, these nebulæ in turn condense and form fixed stars surrounded by cosmical systems. This is the inevitable outcome of the condensation of the cosmical dust expelled from the stars; while the dust collecting into nebulæ is originally dispersed by the intensity of repulsive forces which may be traced to the high temperature and intensity of the light and electric forces operating in the stars. When the nebulæ condense into stars, it is probable that by an unknown circulatory process they again drift back towards the medial plane of the galaxy. Thus, there is an expulsion of dust from the starry stratum,

and a subsequent recovery of this matter in the form of mature stars. We may regard this cyclic process as perhaps the greatest of all the laws of nature." Attention is called to the recognised affinity of the majority of the nebulæ to the poles of the galaxy.

In this briefest possible summary, the steps cannot be traced showing how the author arrives at his various conclusions. Each detail of the structure of the heavens is analyzed with one important exception, the dark stars. Casual mention is made of " dark bodies of planetary size wandering in space," but the opaque non-luminous bodies comparable to the sun in mass are not considered.

We have every reason to believe that the dark stars are exceedingly numerous. Hitherto the study of stellar evolution has concerned itself very largely with the rise, culmination, wane, and extinction of the suns. The new astronomy was lately born and has made a vigorous growth under spectroscopic analysis. In at least sixty cases dark stars may be all but observed telescopically by their passage over the face of luminous suns, producing variables of the Algol class. Naturally different degrees of darkness, down to the absolute, prevail among such stars. There is scarcely an observer of the heavens who has not committed himself to the prevalence of numerous dark bodies, in all regions of the sky, and to the proposition that such bodies were once self-luminous. It has been stated, by Prof. Stoney for example, that the dark bodies far exceed in number the visible stars. Who is bold enough to assert that the light of each sun is from everlasting onward to infinity ? It is as safe to say that each star runs its course to darkness as it is to trace the rise of each from a nebulous cloud ; and the latter proposition Prof. See takes pain to demonstrate. But the revivifying of dead suns through collisions he denies nor is any discussion offered on the existence of such bodies.

A little consideration of the facts forces the alternative, either that the dark stars have some means of rejuvenation untouched upon by Prof. See or else that the cycle pointed out, from star to nebula and from nebula back to star, is inadequate for the maintenance of the visible universe.

The dark stars form a considerable class. Their ranks are recruited by the waning and extinction of light-giving bodies. They must steadily increase in numbers, if, with the author, the absence of means of rejuvenation is admitted. The energy of suns is imparted to the waste places of space in nebulous clouds, from which new suns are born ; but

the givers of light and life, the organized stars, have lost something by the process ; and the loss is cumulative ; therein the argument is briefly expressed. It is immaterial how many new suns are born from nebulæ, all must trace back their origin to the light-giving stars. The loss of energy in these latter is irrevocable ; they must go through the process of waning and decay to darkness. Their offspring, assembled near the galactic poles, may eventually take their places, in their turn only to sink to darkness, after contributing their share to newer nebulæ. The number of the nebula must steadily decrease, with the extinction of parent stars, until they cease their function of fresh star formation, on account of the loss of repulsive forces in the waning and dead suns. Time only stretching into eternity is necessary to complete the process, and of this, the past is quite as immeasurable as the future

Therefore, owing to the inadequacy of the cyclic movement, from stars to nebulæ and back again for maintaining a balance in the making and unmaking of suns, the conclusion must be drawn, either that the heavens in the past were much brighter than at present, and will steadily decrease in brightness, a proposition that postulates an origin and goal that eludes imagination, or else that the dark stars do enjoy a process of rejuvenation. The latter conclusion only is tenable.

[*Popular Astronomy.*

On the Nature and Origin of Sunspots. (*By W. F. Carothers*).—There are some lines of evidence bearing upon the nature and origin of sunspots which I have never seen advanced and I present them herewith. In so far as my remarks are based upon personal observation they are limited to visual phenomena of the past three years. The first half of this period I used a Bardou $2\frac{5}{8}$ inch telescope, while from April 1910 to date the observations have been made with my new and incomparable Clark six inch refractor. During the year 1909 I recorded 80 observations of the sun on separate days ; during 1910, 202 such observations and up to date this year 140.

I refer specially to the hypothesis that sunspots are caused by downpours of cooler vapours from upper strata of the solar atmosphere.

I suppose it is well established that these upper strata have shorter periods of rotation than has the photosphere. This seems to be due to the general contraction of the sun, the outer envelopes bringing in with them their greater velocities. For

instance, if the earth should be brought in to revolve around the photosphere, retaining her present orbital velocity, she would make the circuit in less than two days when the photosphere requires 26 days and upward.

These considerations being true we should expect the spots to exhibit tendencies toward shorter periods than that of the photosphere if they are downpours of vapour falling from more rapidly moving upper strata. Now observation shows that the principal spot in a group and the larger end of the familiar pear-shaped spots take the lead, and, since it is here that we should look for the greater volumes of the descending matter, here also we should expect to see the principal forward momentum reveal itself, and therefore observation sustains the hypothesis in this respect.

Again groups and related spots approximate an east and west formation—as if strewn along from the more rapidly moving upper strata. It may be that this could be explained as a general effect of equatorial acceleration on other hypotheses, and it is not so convincing as the other but it should not be overlooked.

Then, too, the approximately round form of the spots accords with the theory under consideration. If we regard the photosphere as a fiery ocean of vapour, there would be a horizontal pressure against the invading downpours, which would be equal from all sides, thus giving the spots their generally round form. In such case the spots would persist in due proportion to the relative strength of the two forces, and if the downpour should slacken, or if the ocean pressure should increase, the spot would be overcome and effaced.

In this connection I have considered by itself the probable effects of an increase of solar temperature. It would undoubtedly increase the upward pressure of the lower strata, above the photosphere thus tending to prevent the downpours and to lessen the number of spots, and, at the same time, I think it would increase the horizontal pressure of the photosphere before mentioned, thus tending to shorten the lives of such spots as might form.

Of course amateur observations for so short a period cannot be more than suggestive, but if an examination of adequate records should establish it as a fact that the duration of sunspots is relatively shorter during periods of spot minima, that fact would be highly significant, not only with reference to the nature and origin of sunspots, but with reference to the

current problem of variation in the solar temperature, indicating that the temperature of the sun is greater during the spot minima.

This, in turn, would solve the puzzling phenomena of the spot minima and maxima, demonstrating that they are due to periodic variations in the solar temperatures.

[*Popular Astronomy.*

Memoranda for Observers.

Standard Time of India is adopted in these Memoranda.

For the month of July 1912.

Sidereal time at 8 p.m.

		H.	M.	S.
July	*1st*	14	37	5
,,	*8th*	15	4	41
,,	*15th*	15	32	17
,,	*22nd*	15	59	53
,,	*29th*	16	27	29

From this table the constellations visible during the evenings of July can be ascertained by a reference to their position as given in the Star Chart.

Phases of the Moon.

			H.	M.	
July	*7th*	Last Quarter	10	17	p. m.
,,	*14th*	New Moon	6	43	p. m.
,,	*21st*	First Quarter	10	48	a. m.
,,	*29th*	Full Moon	9	58	a. m.