Astronomical Drawings^{*}

Practical Suggestions for Recording Observations

By William Porthouse

THE value of astronomical observations is frequently enhanced if they are accompanied by a drawing or drawings of the phenomenon in question, no matter how elementary the observation or how imperfect one's command of the pencil, therefore the amateur observer should endeavor to illustrate his written observations whenever they lend themselves to such treatment. It is not every observer, however, who knows how to set about the work in the first instance, so that the following epitome of the methods which, generally speaking, I use myself, may be acceptable. It is not implied that these methods are necessarily the best. They have had to be worked out by a system of trial and error, without any art training at all, therefore I am quite prepared to believe that shortcomings exist. The sole idea should be to devise ways and means of recording one's observations so that the result is a pictorial representation which shall be as faithful to nature as is consistent with one's abilities, and capable of conveying a reasonable idea of the phenomenon under examination to a person of average intelligence.

It is not suggested that it is possible to make a finished drawing at the telescope. All my drawings are finished indoors, as are, I imagine, the majority of astronomical drawings. A rough sketch is made at the instrument, and only the material on that sketch is utilized in making the finished drawing. This is not an ideal state of affairs, of course, but so long as the observer is absolutely sincere in his resolve to keep rigidly to what he has actually observed and recorded on his rough sketch there can be no reason in striving for an unattainable ideal.

As regards medium, the stump and crayon method has been found the quickest and most satisfactory in the long run, owing, primarily, to the ease with which erasures may be made. The crayons are known in the trade as "chalk pencils." They are sharpened to a coarse point, which is rubbed on fine glass-paper. The dry color is then taken up from the glass-paper by the stump, which is merely a piece of absorbent paper rolled up and drawn out to a point. The lead in an ordinary lead pencil can be used in the same way, but erasure is not so easy, and the result has not the deep warm velvety blackness of the chalk pencil. Moreover, the surface is much more delicate and liable to be rubbed. Gradation of tone with the chalk medium is readily obtained. Light spots can be taken out of darker areas by means of a pointed rubber. The paper used is in most cases an unglazed drawing paper, having a surface with a minimum of grain, but still rough enough to ensure a satisfactory "bite" on the part of the stump. The chalk pencil is seldom applied to the paper direct, that is, without the use of the stump.

In drawing sunspots the umbra should be outlined first, and the shape of the penumbra sketched in. The detail of the penumbra should follow. Before the umbra is blocked in, the disposition of any bridges should be noted, as it will probably be necessary to leave these blank on the drawing in order to attain the vivid effect of contrast which they always make with the umbra itself. It is desirable to introduce the granulation of the solar surface, taking care that the result is merely a faint suggestion or impression of a granulation, and not a well-defined and heavily contrasted sprinkling. No one can be expected to give an exact representation of what is observed. Conventional methods, therefore, have to be adopted, and such methods, with care and common sense, furnish us with quite reasonable results. An old stump is used for the purpose, and it should be rubbed down on a piece of rough paper, rolling the pointed end during the process, until it has reached such a state as regards freedom from color, that there is little chance of anything too pronounced being left on the drawing. Faculae are introduced negatively, as it were, by taking out the granulated surface to the required extent with the pointed rubber, by which means a very soft and tenuous edge can be obtained. Prominences, being seen a vivid red in the spectroscope, are most effective when drawn with red pencil on black paper.

Mercury and Venus may be readily drawn by means of a compass. The area of the illuminated portion of the disc is given for every few days in the *Nautical Almanac*, with the position of the terminator, so that one can prepare beforehand a rough diagram of the observed planet, which, when taken to the telescope, will probably only require amendment at the cusps if the planet be horned. In this way no time is wasted in making eye estimates of the actual phase. Drawings of the inner planets are best made in monochrome: dark

markings on a white disc. Any suggestions of color received at the telescope are so faint as to be beyond representing without great danger of exaggeration.

Mars at opposition may be drawn by compass, but when near quadrature the pronounced phase will require to be shown. The exact amount of phase is indicated for every other day in the Ephemerides for the Physical Observation of Mars in the *Nautical Almanac*. The best results are obtained by laying on the disc a thin wash of ochre or orange, leaving white patches at the proper points to represent the polar caps. The dark markings are then introduced with the stump, unless their color is sufficiently pronounced to justify tinting them on the drawing. Their color is said to be greenish-grey.

In the drawing of planetary details generally, there seems to be a rule that the general intensity of the markings may be increased ad libitum so long as the relative intensities are undisturbed. Although I follow this rule myself I am willing to confess that it is open to criticism. It would be better if the observed intensities could be rigidly reproduced, without emphasis or exaggeration, even although there may be no intentional deception in the method now practised.

The shape of Jupiter is that of an oblate spheroid, the Polar diameter being one-sixteenth less than the Equatorial. The disc of the planet may be drawn by describing a circle with the compasses, afterwards either cutting down the Polar diameter or increasing the Equatorial to the proper extent. The apparent shape of the disc is practically constant, and therefore it is desirable to cut out of thin card a disc exhibiting the correct amount of oblateness. The edges of this card are rubbed down to a fine and regular curve on glass paper, and the template thus provided will serve to guide the pencil when outlining drawings. The scale of the Jupiter Section of the British Astronomical Association should be adopted, viz., $2\frac{1}{2}$ inches major axis, this being ample for the proper and effective display of all details which are usually observed on the planet.

Personally, I always draw the belts of Jupiter in monochrome, although the colors are sometimes very well defined. The shadows of the satellites are introduced with the chalk pencil itself sharpened to a fine point. A satellite in transit cannot be represented very satisfactorily, unless it happens to travel along one of the darkest belts. The introduction of the satellite by the use of Chinese white is not to be considered at all. A picture of Jupiter is always greatly improved if one or more satellites are sufficiently near to be included in the drawing. Great care must be taken that the satellites are not drawn too large in comparison with their principal: if they are not observed as discs they should not be drawn as such.

Saturn is undoubtedly the most difficult of the planets to represent on paper. It is quite a full evening's work to plot the series of ellipses of which the picture is comprised. These are six in all, viz:—

1. Outer edge of outer ring.
2. Inner edge of outer ring.
3. Outer edge of inner ring.
4. Inner edge of inner ring (or outer edge of crape ring; these rings usually merging into one another).
5. Inner edge of crape ring.
6. Limb of the globe.

In the *Nautical Almanac* is found a page of elements for determining the magnitude and appearance of Saturn's rings for every ten days throughout the year. From these the respective axes minor and major of the six ellipses can be readily calculated and reduced to terms of inches. The resulting measurements are then set out on the drawing paper, and the ellipses are drawn by the simple but perfectly effective thread-and-pin method. Another column in the *Nautical Almanac* gives the inclination of the minor axis of the ring system to the circle of declination, and enables us to pose the planet on the drawing in its proper relation to our meridian. The shadow of the globe on the ring, and of the ring on the globe, are inserted with the pointed pencil itself, and it will sometimes be found necessary to use the pencil in order to obtain sufficient density of the crape ring, which is usually drawn far too bright.

In drawing planets generally, the disc is always surrounded by a background of deep black, the result of which is a considerable improvement in appearance. The production of this black background is far from easy, as it entails two, and sometimes three, coats of Chinese ink before an intense black of even density is obtained.

Occasionally one wishes to plot a field of stars. It does not seem to have struck observers that the most effective way to do this would be to use white ink or pencil on

black paper. The colors of the stars are primarily five in number—white, blue, red, yellow, and green, and pencils of these colors are readily obtainable of very fine quality, and are much more effective on black paper than on white. Comets, meteors, and kindred objects are also best represented on black paper. Occasionally the more striking meteoritic phenomena are accompanied by exhibitions of color, and if one is fortunate enough to witness a good display of this nature, black paper and colored pencils provide the best method of recording it permanently.

The drawing of lunar formations is probably the most difficult astronomical work an amateur can undertake. To make it as easy as possible a skeleton outline of the formation under examination is taken to the telescope, and the observed detail carefully filled in as rapidly as possible. Outline maps merely show the shape of the formation and the disposition and chief characteristics of the neighboring objects, and may be the result of earlier observation, or be made much more accurately from enlarged lunar photographs.

When commencing the finished drawing, the outline of the formation is first either copied freehand or transferred by means of carbon paper. The disposition of the heavy shadows is then traced in, and the shadows blocked in immediately with the stump and heaviest chalk pencil. The pointed pencil itself should not be used for this purpose, as it provides too black a shadow in comparison with the remaining portions of the drawing. Chinese or Indian ink should never be used for the introduction of the shadows either on the Moon or the planets: it should be reserved entirely for the background of the sky, where its great density serves to throw into prominence the picture of the object it surrounds.

After the heavy shadows, the next darkest details are added, and the highest lights left to the last. By taking the details in this order a proper relation between the varying intensities of the picture is maintained. If the high lights are put in first, it may be found at the finish that one cannot get the dark shadow sufficiently black relatively to the other features. It is axiomatic that there should be no areas of untinted paper on the finished drawing, even the highest lights receiving a perceptible amount of color.

One of the most important points in the production of astronomical drawings is size. From the experience of many years I say, without hesitation: "Make them on a big scale, and you will be surprised how fine they look when photographed down." Faults of draughtsmanship and irregularities of curve which would be very noticeable on a small drawing, are relatively smaller on a big picture, and often pass unnoticed.

Few drawings of celestial phenomena, save that of the planet Saturn, convey much to one unless they are accompanied by certain particulars. On every drawing should appear information regarding date, hour, conditions of observation, definition, etc., size and type of telescope used, and magnification employed. On drawings of Mars and Jupiter the longitude of the central meridian should be stated, for both systems in the case of Jupiter. In the case of the Moon, the longitude of the terminator, the age of the Moon, and if possible, the elevation of the Sun above the object delineated, should be given. With these particulars the drawing will always be intelligible to those who are interested in astronomical science.

Emulsions and Suspensions with Molten Metals

FROM a consideration of numerous cases in practice where emulsions or suspensions of molten metals or alloys with solids, liquids, or gases are produced unavoidably, as in the refining of aluminium chips, "floured" or "sickened" mercury, dirty molten sodium, and "blue" zinc powder, or intentionally as in sherardizing and in the production of the lead-copper mixture used for packings, bearings, etc., it is suggested that, if procurable, many stable emulsions of metals normally immiscible in the liquid state might prove of use industrially. Although useful emulsions of gases with metals are rare, it is known that lead made porous by an indirect method is much more efficient than solid lead plate for storage batteries; and it is probable that other metals, if rendered uniformly porous by emulsification with gas while in the liquid state, would find many industrial applications. Investigation of the colloid chemistry of molten metals and alloys would doubtless yield much valuable information.—*Note from the Journal Society of Chemical Industry on a paper by H. W. GILLET in J. Phys. Chem.*

^{*}From the *Journal of the Manchester Astronomical Society*.