The Jupiter Section programme in the new century

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A contribution of the Jupiter Section (Director: J. H. Rogers)

Introduction

The advances in imaging technology in recent years have transformed amateur planetary astronomy. CCD images now provide almost continuous high-resolution coverage of Jupiter at a level previously obtained only in intermittent professional projects. This progress has necessitated a reappraisal of the observing programme of the Jupiter Section.

We intend to maintain the Association's tradition of encouraging both visual and imaging observations, as being equally important in complementary ways. In this article we reprint:

1. A discussion paper on the future role of visual observations, issued by the Section Director in 2000;
2. Comments by members, sent in response to this paper, or made at a Section Meeting in Winchester in 2000;
3. The new Section Programme, published on our web site (**www.britastro.org/Jupiter**) in 2001, and now updated.

1. Discussion paper: The future role of visual observations of Jupiter*

Amateur planetary observation is increasingly dominated by CCD images rather than visual observations. This will be evident when our Jupiter Section reports for 1995 to 1999 are published in the BAA *Journal* next year. Even so, visual observations have still been capable of making a useful scientific contribution. However, I am not sure that this is still the case, now that CCD imaging and computer analysis of the images have become routine. Visual observations will always be a source of pleasure and interest, and the BAA will always encourage them; but should we be rethinking the nature of the observations that are to be encouraged? This discussion paper sets out the changes that are occurring, and some ideas as to what roles visual observations might have in the Jupiter Section in future.

In the early 1990s, when only two or three people were producing routine first class CCD images, visual observers still made an important scientific contribution for several reasons. They could spot new events; they could report them immediately; they could maintain continuous routine coverage; and they were sufficiently numerous that coverage did not depend on just a few individuals. Thus in 1993 during the SEB Revival, and in 1994 during the Comet Crash, all our immediate amateur information came from visual observers; images followed later.

However, by 1999, CCD imaging had clearly overtaken the visual tradition. We now receive first-class images routinely from over half-a-dozen observers in four continents, usually by e-mail. Coverage is essentially continuous. Images typically have higher resolution and contrast than visual observations, and can provide accurate measurements of latitude as well as longitude (free of personal equations and phase effects). Image-based data is preferred by professional scientists as being free of subjectivity, and computer-based analysis by the JUPOS system, now routinely used by the Assistants to the Director, tracks numerous features that are too small for visual tracking. Our reports can be complete and satisfactory on the basis of images alone. Therefore, there is now little to be gained from plotting visual transit data as well, except perhaps from a few very intensive observers.

Certainly we, and others after us, will still want to observe planets with our eyes; and the BAA will continue to encourage observation for pleasure as well as for science. Moreover, visual observations are still possible with less technology and poorer atmospheric conditions than are needed for CCD imaging; and visual observers may still be the first to spot exciting new phenomena, although the chances of doing so seem to be diminishing. The questions for the Jupiter Section are: What should we do with visual observations? What type of observations should we encourage? And, for any suggested activity, who will volunteer to implement it? I suggest four possibilities:

A. Continue to record and plot transits. Observers will understand that this data will probably be only a supplement to image-based data, done for personal interest rather than the likelihood of discovery. An assistant director will be needed to do the analysis, preferably using JUPOS; he or she should calculate and correct personal equations and phase effects.

B. Encourage planetary drawing as an artistic skill. Up to now we have maintained that drawings alone are not likely to be useful; but they will still be welcome as illustrations, and a minority of observers may continue to make artistic contributions. However we would want to avoid giving kudos for seeing ever-finer detail, as this gives an incentive for unreliable observation.

C. Investigate perception of colour, visually and in CCD images. This could be a personal project for one or more people. True

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colours can in principle be measured on multi-filter CCD images, so it should be possible at last to calibrate visual colour impressions, visual red-minus-blue estimates, and colour impressions on CCD images which have normally undergone image-processing.

D. Encourage public participation. Like travel or adventure holidays, visual astronomy is a personal engagement with the real world, in contrast to the world packaged on TV or computer. Can the Jupiter Section offer more to members or local societies to help them with wider public involvement in looking at planets?

2. Replies to the discussion paper

Many observers replied, both from the UK and from overseas, where similar discussions have also been taking place. Everyone agreed that one cannot (and would not) turn back the technological clock, but even if imaging is now superior for positional analysis, visual observation is still valuable in itself, and the BAA should still encourage it. These views were shared equally by visual observers and CCD observers. Most of the latter started as visual observers and emphasised that this was the basis of their skill in judging what is a reliable observation, and of their enjoyment in observing. Here are extracts from some of the letters and messages received.

2.1 Replies from some visual observers

Sally Beaumont:

The word 'amateur' means 'lover', and to me, loving astronomy means standing alone in the dark field or garden receiving in my own eyes the actual photons, star-hopping among the familiar constellations... seeing for myself the dark scars of the Jupiter comet crash or the awesome tail of Hyakutake. The aesthetic pleasure and the sense of wonder will always be more important to me than the scientific aims, but I hope that the latter will still be attainable by the visual observer to a certain extent.

... It would be tragic if [visual observers] were made to feel redundant and less reliable than images produced by the new technology... People who are no good with gadgets... should not be discouraged from the enjoyment of astronomy.

Mike Foulkes:

What is really meant by 'useful'? I can think of three possible definitions.

1. 'Usefulness' to oneself: This must be the key driver and I think is very important. Why do each of us become interested in astronomy and do observing? Because it is interesting, fun, relaxing, enjoyable. It should never be a chore. Just because I could never play football like a Charlton, a Shearer, a Renaldo etc., never stopped me from playing football. If someone enjoys quick glances at Jupiter, or makes transits to visually follow features, or uses a CCD, fine.
2. 'Usefulness' with others: Get any group of amateur observers together, the conversation will often include: did you see this last night, what do you think of this observation, etc. Observers like to see observations by others – no matter what equipment is used. I think that there is still a need for a forum for exchanging observations.
3. 'Scientific' usefulness: i.e. contributing to the science of astronomy in a similar manner to the professionals. This may have been true for amateur visual planetary observations in the past but is probably very much less so now... CCD imaging has given the amateur access to Jovian detail that would have been unheard of years ago. Combined amateur observations can possibly achieve (nearly) continuous coverage at high resolution, allowing more to be followed with increased certainty. Interest increased!

Should the BAA cater for such a range of observing interests, or be limited to super serious observers, armed to the teeth with the latest equipment? Currently the interest range is a broad spectrum, and I think this should be maintained, encouraging amateur astronomy at all levels. I think it would be a shame if visual observations were actively discouraged. Otherwise where do the new observers come from?

Alan Heath:

(also see Alan's letter in the Journal*)*[1]*:*

Surely CCD observations must be in addition to and not in place of visual work... I feel that the Association will suffer if we become 'button pushers' instead of trying to attain the observational skills for which the BAA Sections are renowned.

Richard McKim:

... I also find that the visual observer is good at detecting delicate tints in clouds which can be masked by bad compositing [of CCD images].

I hope that you will continue to use and encourage visual work. Some of today's visual observers are tomorrow's CCDers.

Robert Steele:

We are amateurs and surely there must be interesting avenues for visual investigation – perhaps a discrete object and specific event program – involving intensive visual monitoring of specific predicted events such as expected mergers or interactions of features or as they pass the GRS; colour work on variable features etc.

Visual observers are still in the majority and they have to feel that there is a valued place for them, not a marginal one.

Daniel del Valle (Puerto Rico):

One of the main reasons I began to observe as an amateur astronomer, instead of just sightseeing, was the opportunity to make serious visual observations, in the case of Jupiter with CM timings, disk and sectional sketches, and eclipse timing of its major satellites. Now it seemed, just as I was getting the hang of visual observing, some were saying that this was on its way out, *passé*. I have nothing against CCD observing... however I had to save up to buy my present telescope and accessories, so investing in a system of CCD imaging is a long way off for now.

... The impression can be devastating to those wanting to enter amateur astronomy, especially the young, minorities, and those from developing countries, who for the most part do not have the resources or the time to get into the CCD club.

2.2 Replies from some CCD observers

Damian Peach:

It is always worth observing visually when conditions may not permit images. I think it is also important to encourage visual observation among observers.

Also to be considered is that obtaining high-resolution planetary images is far from easy. It requires a great deal of time and effort to learn how to do it properly, and proper processing of a night's images can take several hours.

Visual observation does not require expensive CCD equipment (and the 'spaghetti junction' of cables that accompanies it). I also find visual observing much more relaxing than CCD work. But again where the CCD excels is in recording very low contrast details, which are at the limit (or beyond) the reach of the eye. This is particularly true for Saturn, and its many low contrast bands.

It is because of some of the above stated factors (cost, difficulty, time constraints etc.) that I think visual observation still has an important role to play. Planetary imaging isn't popular enough to totally overwhelm the worth of visual observations, and visual observations should always be encouraged.

André Nikolai (Germany):

... Watching Jupiter is also an aesthetic event, which no electronic or chemical-based image or any drawing could replace. That's more fun than science. But fun is the stuff which holds our interest to continue this work.

[However]: a dream came true and I changed my pencil for the keyboard. I was overwhelmed by this new observing method. With the aid of *JUPOS* I was able to get 10 times more position data than I got by visual observations and with much more accuracy. In some cases I will continue visual observation with drawings, if the seeing is very flickering so that the image on the chip does not stand still. And just for fun... But for the mean time the CCD imaging is my first choice. More and more observers change to this method. The visual based observation will be a method of the bygone century. But with all enthusiasm, I will not forget the ability of visual observations and do not laugh at one who continues visual observation. [And] it's always the best for beginners to learn observation of planets; later they can change to CCD observations.

Christophe Pellier (France, 2003):

... Good images will not make fine visual observations worthless. Before beginning webcam imaging I have passed six years behind my eyepiece carefully drawing the planets, and my best astronomical souvenirs so far are those observations. Even if you see much less detail, over the years you become more skilful and then you're glad to see that the details captured at the eyepiece, although not numerous, were real... And, if observations serve for analysis, one should not forget merely to have fun while looking through the instrument. Since October I've passed so much time trying to learn how the ToUcam behaves that I haven't made good visual observations, and this is a negative point of digital imaging.

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One common theme was that the expense and expertise required for CCD imaging is a significant limitation. However this is now changing with the advent of high-quality webcams which are much cheaper than CCD cameras and can perform well even under mediocre seeing conditions. As described below, they may well make imaging accessible to many more observers previously limited by budget or by seeing conditions. However, Pellier's comment shows that webcams do not eliminate the need for hard work to achieve good results.

2.3 Discussion at Winchester

A meeting of the Jupiter and Saturn Sections was held as part of the BAA Winchester Weekend on Saturday, 2000 April 15. Similar points were made by speakers in the discussion, and summarised in the report as follows:[2]

'A lively discussion followed. One of the most widespread opinions was that while one could not doubt that the march of technology had led to CCD images taking over for gathering positional data, visual observations were still important for training observers and interpreting images. CCD images were highly susceptible to image processing and could be misleading as a result. It was thus important that CCD workers knew what they were looking for in their images and so visual experience was essential here. It was also pointed out that visual observing still needed to be promoted in order to encourage newcomers and young observers who might not be able to afford a CCD imaging setup.'

3. The BAA Jupiter Section programme*

3.1 Aims of the Jupiter Section

The Jupiter Section membership consists of (i) all observers contributing observations within the last two years; (ii) other BAA members on the mailing list for Section *Circulars* (see below). The Section aims (i) to encourage people to observe Jupiter, and to provide advice on doing so; (ii) to monitor the visible changes in the atmosphere of the planet, and to produce scientifically valuable reports on these changes.

Everything seen on Jupiter is clouds, and our aims are to monitor the currents, colours, and disturbances in the planet's atmosphere. The BAA has been doing this systematically since 1891, and the published Section Reports comprise an incomparable record of changes on the planet. Our observations are still revealing new patterns and new variations. Changes occur on many timescales. The overall pattern of dark belts and bright zones is permanent but can change temporarily, for a matter of years or months. Sometimes there are striking colour changes also. There are many

*Placed on the Section's web site in 2001, and updated in 2003
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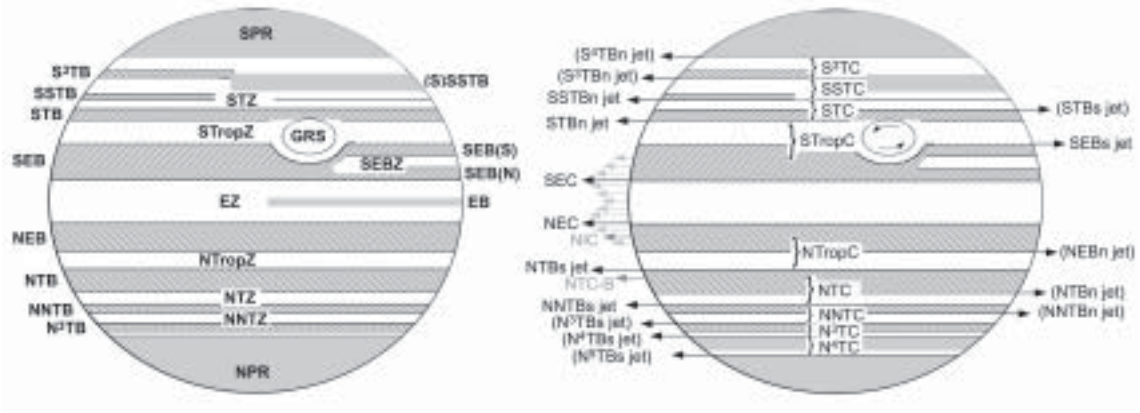


Figure 1. Standard nomenclature for the belts, zones, and currents of Jupiter's atmosphere (redrawn from Reference 3). South is up. *Left:* Standard abbreviations for belts and zones. On the right side are examples of belts commonly observed that are not part of the standard dynamical framework of the atmosphere. *Right:* Names of the prograding jetstreams (left side), retrograding jetstreams (right side), and slow currents (centre). (Jetstreams in brackets are rarely or never observed from Earth.) Slow currents govern the motions of most spots observed from Earth, except those in the equatorial region, and each slow current applies within a domain of latitude bounded by prograding jetstreams. This diagram shows the exact latitudes of the jetstreams, which normally form the boundaries of the belts, so it can be used as a model for drawing, although observers should be alert for deviations from the standard pattern.

'spots' – circulations and storms – which reveal the numerous currents in the atmosphere. They range from the Great Red Spot, which has existed for three centuries, to turbulent disturbances which may change dramatically within a few days. (Full details of the planet are described in Reference 3.) The standard nomenclature of belts and zones and currents has been refined[3,4] since the *Voyager* spacecraft discovered how these visible features are bounded by a regular pattern of jetstreams in fixed latitudes (Figure 1).

Although our reports are now based mainly on CCD images, visual observers still have a chance of spotting new phenomena. In addition, visual observers can monitor the major events on the planet independently, and we will continue to publish visual records of the planet along with the analysis of images.

We have reviewed our conventions, as they differed from the conventions adopted more recently by professional astronomers, and we will adopt the following in future:

– Longitudes (in Systems I or II) will be abbreviated as L1, L2 (rather than λ_1, λ_2 as in the past). Central meridian longitudes will be abbreviated as CM1, CM2 (rather than ω_1, ω_2). This change is to make our reports compatible with e-mail.

– We will continue to use longitude System II for non-equatorial latitudes, rather than System III which is used by professionals. The reasons are: (i) All historical observations have been in System II. (ii) The Great Red Spot, and major features associated with it in the SEB, are almost stationary in System II, so it is easy to point observers to them by L2. However we will give data for conversion to System III in all reports, and we ask imagers to report CM longitudes in all three systems (CM1, CM2, CM3). CM3 can be obtained along with other ephemeris data from a NASA web site: **http://ssd.jpl.nasa.gov/cgi-bin/eph**.

– We will continue to publish images and drawings with south up, for two reasons: (i) This is how visual observers (in the northern hemisphere) see the planet, and we want to maintain the link between our reports and the direct experience of observers. (ii) With this orientation, both longitude and time increase from left to right, allowing a natural integration of numbering systems, cylindrical projection maps, and longitude/time charts.

3.2 Visual observations

We encourage visual observations both by beginners and by more experienced observers. While major features such as belts and equatorial dark projections can be seen with an 8cm telescope, satisfactory observations require a telescope of aperture at least 15cm (6 inches). Beginners should try the following methods of observation, so that they can make useful records if they ever see anything unexpected on the planet. For more detailed advice, please see the BAA observing guide[5] or the Director's book.[3] More advanced observers may wish to specialise as suggested below:

1. *Drawings*. Most people like to draw what they see, and this is a skill that takes some practice to develop. Good drawings are welcomed as illustrations of the general appearance of the planet, and may occasionally be useful as records of special events. The standard size for a disk drawing is 64 by 60mm.

   A more advanced option is to develop one's style of drawing (or even colour painting) so as to combine observational accuracy with artistic quality. Another option is to make strip-maps (cylindrical projection maps) of part or all of the planet, one or more times during an apparition. This gives a valuable overview of the pattern of belts and spots around the planet.

2. *Longitude measurements.* Useful longitude measurements of spots can be made by timing their 'transits'. This does not require any special equipment: one just estimates the time at which the spot crosses the centre-line of the disk (the central meridian). The observer should give the transit time to the nearest minute (which corresponds to 0.6° of rotation in longitude), and calculate L1 or L2 from the tables in the BAA *Handbook*. Any observer who sees an unexpected, possibly novel feature on the planet is urged to make a transit timing.

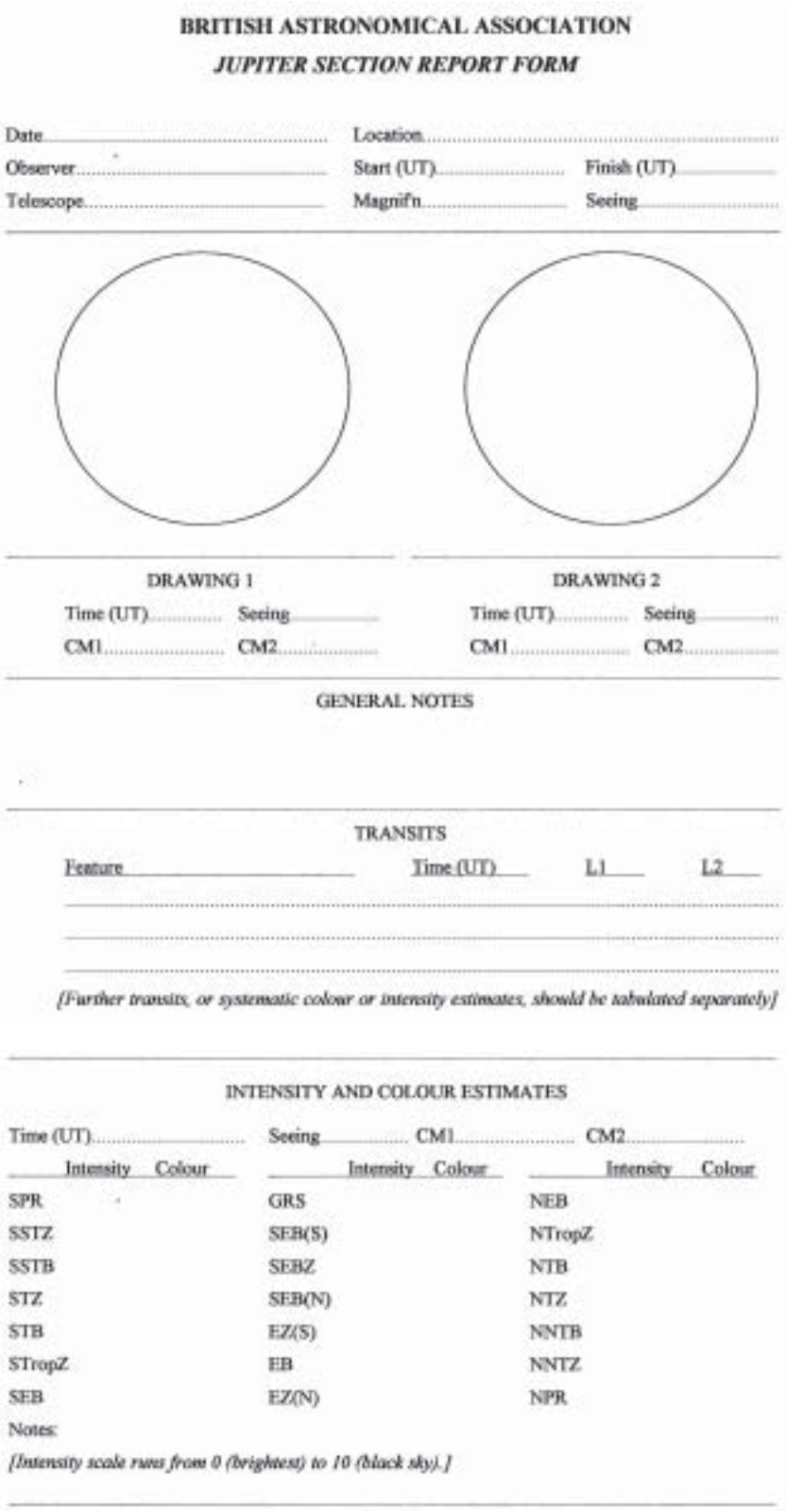
   An advanced observer might wish to make transits systematically through an apparition, accompanying them with sketches, as has been done by the Jupiter Section in the past. If transits are accurate and numerous enough (so that the observer's personal equation can be established), the observer could plot his/her own charts to follow spots on their different currents over several months, and these data could be used as a supplement to image-based analysis. Observers doing systematic transit timings are urged to type in their results in *JUPOS* format, so that they can be put into the *JUPOS* database and plotted on the charts. For the format, see the *JUPOS* web site.[6]

3. *Colour and intensity estimates.* Systematic verbal estimates of colours of belts and zones may be useful, if made with a reflecting telescope of at least 25cm (10 inches). Although there is considerable scope for artefacts, *e.g.* due to subjective contrast effects, this is also true of colour CCD images, *e.g.* due to use of different filters and image-processing. Therefore, visual colour estimation is still a worthwhile project.

Some observers have made intensity estimates of belts and zones through red and blue filters, and this should also be a means of recording colour. A project for an experienced observer could be to systematically compare visual colour impressions, visual red-minus-blue estimates, and colour impressions on processed CCD images, and to calibrate them against absolute intensity measurements on multi-filter CCD images.

Estimates of the intensity (darkness) of belts and zones can be made numerically, on a scale from 0 (brightest) to 10 (black sky). They are inevitably subjective so are only worthwhile if done systematically and repeatedly within the context of a more detailed observational programme. Observers who make colour or intensity estimates should tabulate and average them for the whole apparition, and note any significant changes.

4. *Observations of satellite phenomena.* The transits, shadow transits, eclipses, and occultations of the four galilean satellites are among the most striking phenomena that a beginner can observe. Although observations are not likely to have any scientific significance, observers may like to make accurate drawings of these phenomena, especially when several are occurring at once. Every six years, the satellites occult and eclipse one another, and it is interesting to plot visual lightcurves of the mutual eclipses.



BRITISH ASTRONOMICAL ASSOCIATION

JUPITER SECTION REPORT FORM

Date..... Location.....

Observer..... Start (UT)..... Finish (UT).....

Telescope..... Magnif'n..... Seeing.....

DRAWING 1

Time (UT)..... Seeing.....

CM1..... CM2.....

DRAWING 2

Time (UT)..... Seeing.....

CM1..... CM2.....

GENERAL NOTES

TRANSITS

Feature Time (UT) L1 L2

[Further transits, or systematic colour or intensity estimates, should be tabulated separately]

INTENSITY AND COLOUR ESTIMATES

Time (UT)..... Seeing..... CM1..... CM2.....

Intensity	Colour		Intensity	Colour		Intensity	Colour
SPR			GRS			NEB	
SSTZ			SEB(S)			NTropZ	
SSTB			SEBZ			NTB	
STZ			SEB(N)			NTZ	
STB			EZ(S)			NNTB	
STropZ			EB			NNTZ	
SEB			EZ(N)			NPR	

Notes:

[Intensity scale runs from 0 (brightest) to 10 (black sky).]

Figure 2. Report forms for visual observations (reduced for reproduction). The actual forms have disks 60×64mm for drawing, and more space for notes and transits. Forms can be sent to observers by e-mail or by post, or observers may adapt them themselves.

Contributing visual observations

New report forms have been designed (reproduced in miniature in Figure 2). These will be sent to members who request them from the Director, either as hard copy (in which case, please make extra photocopies yourself), or as *Word* files by e-mail. Observers are invited to use whichever form is more suitable for the observations they choose to make, or to adapt them. Please report observations about once a month during an apparition, and let the Director know at once if you see anything unusual happening on the planet.

Visual observations should be sent as hard copy to Mike Foulkes: 20 Queensway House, Queensway, Hatfield, Herts. AL10 0LR; tel. 0170727 1124; [mike.foulkes@btinternet.com]. Mike can accept original drawings, or good photocopies, or printouts of scanned observations. Send a stamped addressed envelope or an e-mail address if you would like acknowledgement.

Drawings can be accepted by e-mail if necessary, but please do not use this method for large quantities, nor for drawings with black surrounds, as these will not be printed off! When good copies are required for publication, we will request them by e-mail if available. If visual ob-

servers do send drawings by e-mail, please use the file naming system recommended for images below. If you would like to form an informal 'newsgroup', we will be happy to put you in touch with other members who also send drawings by e-mail.

3.3 Imaging

CCD imaging has transformed the amateur record of the appearance of Jupiter. Images can enhance Jupiter's rather low contrast, and can provide accurate measurements of both latitude and longitude. For the Jupiter Section, these measurements are now made using the computer-based *JUPOS* system, and they enable us to track numerous features large and small.

A telescope of at least 15cm is needed for high-quality images. For technical advice, contact the BAA Instruments and Imaging Section, or some of our major contributors. Particular challenges with Jupiter are the low-contrast image and the strong limb-darkening. Therefore, points to consider are:

– Adding many short exposures can be preferable to taking single exposures;

– CCD chips are most sensitive in the near-infrared, so an unfiltered image looks like a red-light image (with rather low contrast though potentially fine detail), and may suffer particularly from chromatic dispersion. Imagers are recommended to use an infrared exclusion filter;

– Because of limb-darkening, some form of digital unsharp-masking is needed to bring out the limb, to enable longitude and latitude measurements to be made. Most images that we receive are already processed to reduce limb-darkening and enhance contrast, and sometimes to sharpen edges. Such image-processing should be done judiciously with awareness of the artefacts that it can create; check that there are not conspicuous rings around satellite shadows, nor any saturated white areas in the image. Sharpening in particular may enhance the appearance but make it less reliable;

– Images in different filters can be very informative as one sees different levels in the atmosphere in different wave-bands. There is little variation across the middle of the visual spectrum but violet or deep blue (which require longer exposures but are better than broad blue), and red, give good discrimination. Near-UV (~360 nm) and near-IR (~800 nm) show even greater differences;

– Methane-band imagery, at 890 nm, is now within the range of amateurs with large telescopes and large budgets.[8]

Traditional photography of Jupiter is difficult, requiring long exposures and high resolution. It has now been superseded by CCD imaging.

CCD imaging may now itself be largely superseded by webcams. Many observers are switching to webcams as they are much cheaper and can perform well even under mediocre seeing conditions. Recently they have enabled new observers to produce some of the best images ever obtained, even with a 250mm telescope, while plenty of detail can be recorded even with a 180mm telescope. Webcams also produce colour images without the need for filters, although these may not be as selective in the blue as one would wish for planets.

A webcam such as the Philips ToUcam Pro can be used with any good modern PC, with a large hard disk drive (preferably at least 10 gigabytes) to accommodate the large files generated. An adaptor can be purchased to fit the webcam (minus its lens) to a standard 1.25-inch drawtube. Focusing is done by watching the real-time image on screen. Then, for Jupiter, one typically captures hundreds of images within a period of less than a minute, each of 1/25 to 1/50 seconds. The output is an AVI video file. The images are then processed using software such as *Registax* (available for free download). This will automatically superimpose several hundred images, rejecting low-resolution ones by means of a fast Fourier transform, to create the single much cleaner image that one desires. The image can then be processed as considered above for CCD images, and converted from an AVI file to a JPEG image file, using a standard graphics program such as *Paint Shop Pro*. More specific information on using webcams can be obtained from Damian Peach, [dpeach_78@yahoo.co.uk] or other current contributors, and in references 9 and 10.

Contributing images

Please send images, by e-mail or on disk, to Hans–Joerg Mettig [H.J.Mettig@t-online.de], or Damian Peach [dpeach_78@yahoo.co.uk], and also send any particularly good or important images to the Director [jhr11@cam.ac.uk]. They are more likely to be used for analysis if sent to us directly rather than just being placed on a web site. Also send a copy to the International Outer Planets Watch [ijw@nmsu.edu] where professional astronomers keep an up-to-date archive of images on their web site: **http://atmos.nmsu.edu/ijw/current_images.htm**.

File names should be written in the order year-month-day, followed by the observer's initials; e.g. **2003feb01_abc**. Although the IJW database uses the format abc030201 to encode the initials and date, we prefer to avoid post-millennial and trans-atlantic confusion by writing the year in full, and using a 3-letter abbreviation for the month. Please include the same information in the subject line of your e-mail. You may include several images from one night in one file. If the file contains a single image, please include the time (always in UT, and preferably accurate to a tenth of a minute) in the filename, to facilitate filing in the JUPOS database; thus, **2003feb01_23305_abc** (for an observation on 2003 Feb.1 at 23h 30m 30s UT by observer ABC).

Please write all essential data on the image (not as a separate text file). This should include the full date and time (UT); CM1, CM2, CM3; your name, and the colour channel(s) used. If you use different cameras or telescopes, or observe from different countries during the year, it is useful to have this information on the image also.

Like all amateur recorders, we strongly prefer south up in images, as noted above. We recommend that you make the belts horizontal, because images have to be horizontal if used for montages or maps. Unnecessary rotations may degrade resolution.

The preferred format is a JPG file of 'high' quality (not 'maximum', to avoid very large files, but not 'medium' as

this may degrade the image). Please use enough pixels to preserve the full resolution of the original image.

3.4 Analysis of observations

The main quantitative analysis is measurement of longitudes and latitudes of spots, and tracking them in longitudinal drift charts. This is now done from CCD images using the computer-based *JUPOS* system, created by Hans–Joerg Mettig and Grischa Hahn.[6,7]

This allows for:

– Interactive measurement of positions of spots from images on screen (using any image format);

– Manual input of longitudes from visual transits, if these are provided as a consistent set tabulated in *JUPOS* format (see the web site);

– Output as longitudinal drift charts.

3.5 Section reports and *Circulars*

Formal printed Section *Circulars* are now being discontinued, in favour of more frequent e-mail bulletins. The principal address list will be the e-mail address list, comprising Section members in the UK and all contributors worldwide. E-mail bulletins are sent out whenever appropriate (approximately once a month during apparitions). Printed text copies can be sent to members in the UK if you supply the Director with some stamped addressed envelopes.

We expect to publish full reports for each jovian apparition in the BAA *Journal* in the usual style. Important events are also reported in the news columns of the *Journal*, and in both paper and e-mail BAA *Circulars*.

Address: 10 The Woodlands, Linton, Cambs. CB1 6UF [jhr11@cam.ac.uk]

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Respuesta:1. The moon is the closest planet to earth. (close) 2. Jupiter is the largest planet in our solar system. (large) 3. Sirius is the most brilliant staâ€¦Â The Apollo project was the space programme. It cost 25 541 400 000 dollars. (expensive) 11. Mercury is the planet in our solar system. (small) 12. Romenko is the man in space. He spent over 420 days in space. (experienced) 13. Pluto is the planet in our solar system. (cold) 14. Venus is the second object in the solar system. (bright) 15. Jupiter has the day of all planets. (short) 16. Uranus hits the temperatures of any planet. (cold) 17. Mercury is the planet in the solar system. (cratered) 18. Saturn has the rings in the solar system. (extensive) 19. The Uranian moon is Miranda. It has ice c Jupiter holds a unique place in the history of space exploration. In 1610, astronomer Galileo Galilei used a new invention called the telescope to look at Jupiter and discovered the first moons known to exist beyond Earth. The discovery ended incorrect, ancient belief that everything, including the Sun and other planets, orbited the Earth. Size and Distance.Â Orbit and Rotation. Jupiter has the shortest day in the solar system. One day on Jupiter takes only about 10 hours (the time it takes for Jupiter to rotate or spin around once), and Jupiter makes a complete orbit around the Sun (a year in Jovian time) in about 12 Earth years (4,333 Earth days). Its equator is tilted with respect to its orbital path around the Sun by just 3 degrees. In the USA a documentary called PLANDEMIC, which exposes COVID-19 as a criminal operation, is supported by over 27,000 medical doctors! Why are these thousands of medical professionals worldwide saying the pandemic is a crime? What information do they have access to, that we are not getting from the mainstream media?

Project Jupyter exists to develop open-source software, open-standards, and services for interactive computing across dozens of programming languages. JupyterLab: Jupyterâ€™s Next-Generation Notebook Interface. JupyterLab is a web-based interactive development environment for Jupyter notebooks, code, and data. JupyterLab is flexible: configure and arrange the user interface to support a wide range of workflows in data science, scientific computing, and machine learning. JupyterLab is extensible and modular: write plugins that add new components and integrate with existing ones. Try it in your br Since it is the fourth brightest object in the sky, Jupiter was observed since ancient times and thus no one can be credited for its discovery. However, the first telescopic observations were conducted by Galileo Galilei in 1609 and in 1610 Galileo also discovered the major moons of Jupiter, but of course not the smaller ones. Since many cultures observed Jupiter, they all gave it different names but the Roman name remained used in the majority of cultures. Jupiter is named after the principal Roman god, the equivalent of the Greek god Zeus. Jupiter is one of the five visible planets (Mercury, Jupiterâ€™s trine to Uranus opens us up to new energies, approaches, and attitudes, which is particularly useful with Jupiter in the traditional sign of Capricorn. Fortunate events occur as a direct result of our willingness to entertain the unusual and to think outside of the box. This transit favors group activities, financial endeavors associated with groups or organizational efforts, educational pursuits, writing, publishing, speaking, and humanitarian efforts. In the fifth section, an exact solution to the Navier-Stokes equations will be found which corresponds to a rotating viscous fluid with stationary velocities. This solution can be applied to describe the observable phenomenon of differential rotation of the visible surfaces of stars and gas giant planets in which their angular velocity decreases with increased latitude [11][12][13][14]. ...Â Jupiter has the largest magnetosphere in the solar system and its properties act as a useful counterpoint to Earth (Bagenal et al. 2007). Its interaction with the solar wind is very different to that of the Earth's magnetosphere, and this is due to its strong magnetic field, its rapid rotation, and the presence of internal plasma sources (Delamere and Bagenal 2010). A new study on the binary asteroid Patroclus-Menoetius reveals that within the first 100 million years of the solar system's existence, Jupiter and Saturn shoved Uranus and Neptune away from the sun towards the Kuiper belt, a mass of primordial celestial bodies, in a kind of cosmic eviction. The binary asteroid consists of a pair of celestial bodies both roughly 100km (62 miles) in diameter that are found within the Jupiter Trojan belt, a mass of objects that orbits the sun in line with the gas giant of our solar system.Â How exactly did jupiter and saturn do this? In what order were the planets captured by the binary sun-jupiter system in the first place?