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CLIMAX ANNUAL REPORT - 1962

Introduction

In looking back over the year at Climax two things stand out: The installation of and the first observations with the long-awaited 16 inch coronagraph; and the trend that was established toward more research participation by the Climax staff. These items will be elaborated on in following paragraphs. Perhaps the best way to summarize the year is to discuss each phase of the Climax operation in turn, and the following paragraphs will follow this scheme.

16 Inch Coronagraph

The 16 inch coronagraph first saw the light of day as an idea in about 1948; actual work began on the instrument in 1958; and now 1962 has seen the completion of the telescope and the first observations obtained with it. Installation began in April, with the entire dome and spar drive systems being given a complete overhaul in preparation for the new instrument. This included, among other things, the complete rewiring of the 26 foot spar and its controls, guider, and the K-coronameter, and a thorough checkup of the mechanical systems. During the summer months the mechanical mounts and covers were installed, and finally the optical elements were put in place this fall. Perkin-Elmer did the optical work. Alignment of the optics, a time-consuming job, was carried out in September, October, and early November. The completed instrument is an f: system, utilizing a Mangin mirror for the O₂ lens to provide a color-corrected image at the slit of the spectrograph. As in the design of the 5 inch coronagraph, the light from the 16 inch is fed down the polar axis by a Coude mirror arrangement to the spectrograph, which is housed in a heated room. The spectrograph is now under construction, and will be installed early in the summer of 1963. Even without the spectrograph the instrument can be used effectively for certain types of observations, and the first such were obtained during the first week in December. A group from Southwestern University used the 16 inch to feed light to an infra-red spectrometer in an attempt to observe new coronal and chromospheric lines in the region from 1.0 to 2.2 microns. A large coronagraph is essential to the success of their work outside of a natural eclipse because of the low light levels encountered in the emission lines. Very preliminary reduction of their data has given definite indication of lines at 1.52 microns and 2.16 microns. Immediate plans now call for the use of the 16 inch to feed light to an H_α birefringent filter for disk observations on a larger scale than is presently possible with the standard Flare Patrol. This work will occupy much of the available sky time until the spectrograph is installed. Also under construction is a magnetograph to be coupled to the 16 inch for studies of the magnetic field configurations in prominences - although

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this instrument is still about a year from completion. ¶ A number of tests have been run on the performance of the telescope, and more will take place prior to the installation of the spectrograph. These have been concerned primarily with the scattered light in the instrument, and indicate a preliminary scatter figure of 40 millionths in the near red spectrum.

5 Inch Coronagraph

The 5 inch coronagraph continues as the workhorse instrument of the Climax station, despite the amount of attention being given to the 16 inch, and it is felt that the 5 inch will always perform a very useful function in our observing program since it is a much more flexible telescope. In fact, there are many programs now being worked on with the 5 inch that probably will just not be possible to do with the 16 inch. In other words, the feeling is that the 5 inch coronagraph will not be made obsolete by its larger neighbor.

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Too verbose?

¶ One of the most interesting items attempted with the 5 inch during the year was the use of a triplet objective lens for coronal observations. Scattered light from the surfaces of a triplet lens should theoretically be very high - perhaps too high for coronal work. Our tests on an admittedly very high quality lens indicated an increase in scattered light of about 28% over our singlet lens. The triplet was good enough in fact that we are presently using it for all observations while the singlet is repolished and checked for scattered light. In the future the plan is to use the triplet for observations covering several hundred Angstroms - thus having all the observation in focus - and to use the singlet for those observations that cover only a few Angstroms. ¶ The Barium II program was started ~~this year~~ and very nearly carried to a successful conclusion all ^{the} this year - only a couple more sets of observations ^{are} needed to wind it up for reduction. The hope was to observe the Barium II lines in prominences, and the multiplets I and II have been successful - anything with a Rowland intensity of 4 or less has been very difficult. ¶ Excellent observations were taken in conjunction with the eclipse in New Guinea on 4 February of this year consisting of not only the standard red and green coronal studies and H_α studies, but also active region studies on very interesting loops that occurred at the limb at eclipse time.

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Another interesting type of observation inaugurated this year was the slitless spectra observations of H_α, H_β, D₃, H & K lines, and 10830 of He. This program is still in its early stages, but the hope is to study prominence structure in the 10830 line for comparison with the flare patrol H_α pictures. ¶ A program to observe eruptive prominences was put into motion and several sets attempted, but ^{eruptives} they are elusive and difficult to catch and also rather infrequent at this time of the solar cycle. ¶ There were a number of other new programs started this year, as well as additions and changes to existing programs, and we are finding that with activity at a much lower level there is time to more fully test and work on problems connected with the instrument than ever before. One area that will receive much attention in the near future is the scattered light problem that has never been fully explored in this telescope. There is hope of appreciably reducing the scattered light by painstakingly experimenting throughout the instrument. Also planned for the near future is the remoting of the main electronic units in the small dome into an adjacent heated room - in fact this has already begun.

Image Tube

Major revisions have been made in the image tube in the last few months, but prior to that some interesting work was carried out with the tube still in a somewhat unsatisfactory condition. The chromospheric spectrum beyond the 10830 line of Helium was explored, and it was found that the tube could operate out to the atmospheric cutoff around 13500 Angstroms. It may be possible to pick the spectrum up again beyond this cutoff, but a thorough attempt has not yet been made. The 12818 Angstrom line of the Paschen Series was observed on a number of occasions through the tube during this search of the spectrum.

In October the tube was removed to Boulder where a new double-length tube was installed. This went ~~xxxx~~ into operation at Climax in November, and the results have been very gratifying. The new tube is roughly $2\frac{1}{2}$ times faster than the old tube, thus reducing the exposures to about three minutes - a very significant gain for the observing technique. The tube has better resolution, and this has been coupled with the installation of a different relay lens and a shifting of position of the transfer lens to give a slightly over-magnified image. The result is a much larger, sharper image with better detail. This new setup on the tube is just getting underway now, but it already appears that it is going to not only improve on such old standard programs as the Iron Series, but will make feasible some programs that were not possible in the past.

Flare Patrol

A number of notable and rather major improvements were made in the flare patrol instrumentation and operation procedures this year. I will list these with a brief description ~~xxxx~~ concerning each:

1. Exposure meter - a non-automatic device that measures the brightness of the face of the sun thus enabling the observer to adjust the film exposure for time of day and cloud effects.
2. Automatic altering of standard exposures - this gives us a more versatile and usable photographic coverage of the sun by varying the normal picture. It consists of every tenth disk picture being taken without the usual limb picture superimposed (for better limb determination), and then this is followed by a normal disk and limb double-exposure attenuated by about 60% with a neutral filter (to avoid over-exposing bright events).
3. Commercial film processing - all of the flare patrol film is now processed commercially by Dakota Microfilm Service in Denver. It is developed in their standard Microfile developer for 3 minutes and 20 seconds in a continuous processing machine. The result is a generally more consistent development than we can give with hand processing.
4. Duplopan-Rapid Film - In August, after a good deal of testing, we changed from Kodak 5E film to Gevaert Duplopan-Rapid.

It offers many advantages including 10 times faster speed with no apparent increase in graininess, lower cost, more adaptable to commercial processing. We are presently using this film in 200 foot rolls which, with our picture-taking rate of 6 per minute, means some less down time for film changing in the camera.

5. A number of tests were run on the instrument. Among these was a rather exhausting test of the new Acufine developer with the conclusion that it does offer an increase in grain quality and speed both, but is more awkward to handle on a large film volume basis and considerably more expensive. Tests were also run on larger image sizes than our present 10 mm - up to 15 mm was tried with the result that this kind of increase does not yield a significantly better image. And finally the lucite bandpass tests should be mentioned because of their uniqueness. Having a coronagraph-spectrograph combination mounted with the flare patrol presents an excellent opportunity for monitoring the tuning of the birefringent filter in the patrol. By means of a piece of lucite that was bent to shape light was fed from the filter into the spectrograph and photographed in comparison with H α spectra of the sun. Very accurate tuning of the filter can be accomplished by this technique. The only drawback is that both instruments are tied up for long periods of time since the exposures require $\frac{1}{2}$ to 1 hour apiece.

Future plans for the flare patrol will include a system that contains both a 35 mm and a 70 mm camera mounted so that a quick change can be made from one to the other. This would mean that a very large image photographed on 70 mm film would be utilized during good observing periods, and the present 35 mm setup would be used the rest of the time. A prototype of the 70 mm camera has already been built, and it is hoped that the system can be built during the coming year. It would enable us to exploit more fully the capabilities of the instrument.

K-Coronameter

Chris Heynekamp, a member of the Boulder staff, moved to Climax with his family for the period January through May for the express purpose of operating the K-coronameter. The result of this arrangement was a very complete and knowledgeable operation of the instrument such as had not been possible before. Although no major changes were made in either the instrument or the observations, much sounder data was produced. This underlines the importance of having someone very concerned with the data that is produced by each instrument - someone who is looking at and using the data as it is obtained.

The coronameter was taken out of operation for the period May through October in order to facilitate the installation of the 16 inch coronagraph. During this period the instrument was rewired, and some of the control bugs were eliminated. Future plans call for an HAO staff member, Dick Hansen, to take the coronameter to Hawaii next summer and operate it there for a year. Hawaii will provide a greater amount of coronal sky than Climax, and the coronameter requires several hours of clear sky for one good set of complete observations.

Housing

The housing problem at Climax is always critical, and this year saw two more steps taken toward alleviating the situation:

1. A three-bedroom house trailer was moved onto the site under a lease arrangement at the start of the year. This is intended to provide much needed guest housing facilities - principally for guests that can make an extended stay of several weeks or a few months. The hope here is to encourage members of the scientific staff to spend some time at Climax. We also desire graduate students to come up and do research with the Climax instruments, and the trailer should be an incentive in that direction. The trailer makes it possible for a person to bring his family with him - in the past there has been a reluctance on many people's part to stay at the station very long since they are away from the family. The trailer was used by Chris Heynekamp for six months at the start of the year while he did his work with the coronameter, and then his visit was followed by a three month stay in the trailer by Dave Davidson of the electronic shop who was doing much of the rewiring of the 26 foot spar.
2. A 14 by 30 foot addition was built onto the existing Harvard House. This makes the house into a comfortable two bedroom dwelling with a large living room and a den. In effect, it makes a full size house out of what was a very small house unsuited for the long winter inside life necessary at this elevation.

There is still a strong need for additional housing at the station either as replacement for existing housing that is inadequate or as new, additional facilities that will enable more permanent staff members to live at the site. This new housing should be at least a three-bedroom unit, and the cost of such a unit would be \$20,000 to \$25,000. This would represent a fair investment in the site, but the time has come when we must find a way to channel some funds toward better housing for the personnel who are operating the very elaborate and expensive equipment that we have already installed. Winters are long at Climax, and the resident at the site must spend much of his time inside his home; therefore it is sound to consider making this home at least adequate and comfortable.

Manpower

This fall, for the first time in at least six years, no one resigned from the observing staff at Climax. This was an enormous help with the fall observing which is generally the best of the year, and this year was especially good because of the prolonged dry spell that gave Climax a high percentage of clear sky.

→ There is a strong need for an increase in the present observing staff to five persons since the advent of the 16 inch coronagraph. The present staff has adopted a specialization scheme in the operation of the station which, it is hoped, will accomplish several things:

Make specializations and research intents by a staff a separate paragraph

It will provide better quality data by having one person at least who is very concerned with a certain type of observation and its problems; and it should increase the job interest for the staff since each person has an area of responsibility in which to exercise his own judgement and initiative. In practice so far (the system has been in effect only a few months) it seems to be working alright. The four observers have been divided among the instruments, so to speak, such that there is a man on the 5 inch coronagraph, on the image tube, and on the flare patrol in the small dome, and currently one man in the big dome working on the 16 inch and the coronameter both. The need for the fifth observer is felt in the big dome - there should be two men available to work there. This need will only be magnified in the near future as the 16 inch goes more and more into full scale operation, so now is the time to obtain another person and begin training him in order to be ready, staff-wise, for the increased load we will have a few months from now. It is hard to accurately evaluate the cost of an additional observer since the housing problem enters into the picture so much. The salary involved would probably be in the \$5000 area, but the man may be housed in Leadville and forced to commute and this brings up many unsettled and even undiscussed problems. The present plan is to go ahead and interview for a new man, and this is already underway.

There is a growing feeling that more electronic support is needed at the station. At the present time the people in the Boulder electronic shop make weekly or bi-weekly trips up for the purpose of electronic repair and improvement. This is not only inefficient, but is not desirable from the general standpoint of those making the trip. There is discussion of perhaps hiring a man who will reside at the site and perform principally electronic duties. This is still in the pondering stage, but it may represent a substantial expenditure increase in the coming year if decided on. Right now there is enough electronic work at the station to occupy a man full time, and the plans for the spectrography and magnetograph installation and operation in the near future may well make such a move mandatory.

Site

The only anticipated major site expense in the coming year, other than the housing problem already stated, is the need to rework a portion of the sewer line and the septic tank setup. This involves raising the inlet to the tank (which means a probable relaying of about 100 ft. of sewer line), and lowering the outlet. The cost will be \$300 to \$500, and will eliminate a very bad situation that is a potential cause of sewer line plugging.

One other item is a possible expense in the coming year, and that is the installation of a water softener. The water at the site is very hard and nearly unpalatable much of the year. A softener would go far toward remedying this. However, no cost estimates or investigation of the problem have been made yet. An out-of-the-air guess as to cost would be around \$600.

Conclusion

The Climax site is growing substantially in instrumentation now, and to keep pace with this growth and utilize our scientific investment to its fullest we must be prepared to invest more in staff and support facilities

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