FASCICULE 1
Astrophysique N° 1

NOTES ET INFORMATIONS

Publication de l'Observatoire de Paris

OBSERVATIONS DE LA NOVA RÉCURRENTE R S Oph.

B. FOLKART, J.-C. PECKER, S.R. POTTASCH, J. ROUNTREE-LESH
(Service d'Astrophysique générale, Observatoire de Meudon)

Observatoire de Paris - 61, avenue de l'Observatoire - Paris - XIV°

Mai 1961

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Toutes les communications relatives à la rédaction doivent être adressées à M. le Directeur de l'Observatoire de Paris, 61, avenue de l'Observatoire, Paris 14°.

AVERTISSEMENT

Avec le Bulletin Astronomique, que l'on trouve dans toutes les grandes bibliothèques, l'Observatoire de Paris dispose d'un moyen largement répandu d'expression et de diffusion, du reste ouvert à tous les auteurs sans distinction d'appartenance. Cette publication, dont la création remonte à quatre-vingts ans, a subi au cours du temps diverses transformations ; c'est aujourd'hui un recueil de Mémoires, c'est-à-dire d'ouvrages longuement médités, rédigés sous une forme définitive, et que le Comité de Rédaction prend la responsabilité de soumettre aux lecteurs.

Il a paru opportun de constituer parallèlement une seconde collection où seraient insérés des textes d'une autre nature, tels que des projets d'observations, d'instruments ou même de théories, sur lesquels on désire connaître l'avis de spécialistes avant de leur donner leur plein développement, ou encore des résultats d'observations, avec, éventuellement les conclusions provisoires de leur discussion.

Si ce titre n'avait déjà beaucoup servi, on aurait pu intituler cette nouvelle collection : Notes préliminaires. Les Notes et Informations constitueront une série unique, mais sur chaque fascicule figurera l'un des trois sous-titres suivants : ASTROMETRIE, ASTROPHYSIQUE, DIVERS, ce qui permettra aux lecteurs et aux bibliothécaires de subdiviser la collection s'ils le jugent bon. Sous la rubrique DIVERS, paraîtront notamment des rapports sur l'activité des divers services de l'Observatoire de Paris.

Des dispositions seront prises pour assurer la publication aussi rapide que possible des manuscrits qui parviendront à la Rédaction. Les fascicules ne paraîtront donc pas à date fixe, mais au gré des circonstances. Les auteurs appartenant à des établissements autres que l'Observatoire de Paris pourront soumettre au Comité de Rédaction les textes qu'ils désireraient voir insérer.

A. DANJON
Directeur de l'Observatoire
de Paris

RAPPORT PRÉLIMINAIRE SUR L'ÉTUDE DE L'EXPLOSION 1958 DE LA NOVA RÉCURRENTE RS OPHIUCHI

B. FOLKART, J.-C. PECKER, S.R. POTTASCH, J. ROUNTREE-LESH

(Service d'Astrophysique générale, Observatoire de Meudon)

Le spectre de la nova récurrente RS Ophiuchi a été observé aux observatoires des Mts. Wilson and Palomar, sur un domaine spectral étendu (3800-8500 Å) pendant 2 semaines, presque chaque nuit, comme indiqué sur le tableau I. Une étude préliminaire de ces spectres a été faite par Wallerstein (1959) et les plaques nous ont ensuite été confiées par le Directeur des Observatoires des Mts. Wilson and Palomar.

Notre projet comporte :

1/ l'établissement d'une liste des raies observées en fonction du temps;

2/ la mesure des longueurs d'onde de ces raies, à l'aide du spectre de comparaison de l'arc au fer;

3/ l'étude détaillée, en fonction du temps, de raies sélectionnées. Les plaques ont été calibrées grâce à des spectres gradués obtenus à l'aide d'un diaphragme triangulaire;

4/ la détermination des intensités relatives des raies (décrément de Balmer, pour les composantes étroites et larges; raies interdites ...). Cette mesure repose sur une calibration photométrique de l'ensemble du spectre grâce à des mesures simultanées en 3 couleurs, effectuées par Connelley et Sandage, et aux mesures d'autres auteurs.

Nous avons actuellement accompli, pour la plupart des raies intenses, les points 1 et 2 de ce programme. Les résultats sont rassemblés dans la table II. Les longueurs d'onde pour les raies larges d'émission indiquent les pics d'émission, mais aucune utilisation ne doit en être faite, la seule grandeur précise devant venir d'une analyse des profils. Il faut remarquer le dédoublement des raies fines d'absorption du calcium ionisé : l'une des composantes est sans doute interstellaire et l'autre circumstellaire.

Nous avons l'intention de compléter les points 1 et 2 par une recherche systématique de toutes les raies fines grâce à un examen détaillé des enregistrements comparés les uns avec les autres (ces raies fines ne sont pas détectables par un simple tracé moyen au travers d'un enregistrement isolé). Le point 3 de notre programme est en cours de réalisation; le point 4 sera examiné ensuite.

Dans notre interprétation ultérieure des résultats obtenus, nous avons l'intention de nous limiter à l'étude détaillée des couches extérieures, circumstellaires, de la nova. Dans ce but, nous nous proposons d'étudier spécialement :

a) les raies interdites de l'oxygène, de l'azote, du néon;

b) les raies de l'hydrogène;

c) les raies de CaII et de HeI;

d) les raies interdites de FeII.

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PROGRESS REPORT ON THE STUDY OF THE 1958 OUTBURST OF THE RECURRENT NOVA RS OPHIUCHI

B. FOLKART, J.-C. PECKER, S.R. POTTASCH, J. ROUNTREE-LESH

On July 13, 1958, a new outburst of the recurrent nova RS Ophiuchi was discovered. This was the third outburst known, the previous ones occurring in 1898 and 1933.

The spectrum of the nova was observed at the Mount Wilson and Palomar Observatories in a wide spectral range, $\lambda = 3800$ to $\lambda = 8500$, beginning on the same night and continuing on almos each successive night thereafter for a period of two weeks(1). The decline of brightness of this nova is very rapid, but it is likely that the first spectra were obtained very close to maximum light, and probably not more than a day or two after the outburst began. During the period discussed here the decrease in brightness was about 3 magnitudes.

An initial discussion of the wavelengths and possible origin of the sharp lines observed in these spectra was made by Wallerstein (1959). The plates have since been generously loaned to us by the Director of the Mt. Wilson and Palomar Observatories for further study. The plates under study are listed in Table I, which gives the date and time they were taken, the wavelength region covered and the spectral dispersion. The plates were all taken with a grating spectrograph so that the dispersion is constant along the length of the plate.

The spectrum is different from other novae in that it shows, along with the broad absorption and emission features, many narrow lines seen in both absorption and emission. These lines probably originate in an extended shell or cloud of material which surrounds the nova, as evidenced by the fact that eventually these sharp lines disappear (traces of these lines are still seen 3 weeks after the outburst was first noted). Thus the determination of the properties of this extended cloud (especially its mass and chemical composition) are an added interest in the interpretation of these spectra.

Our plan in reducing these spectra is to proceed in the following manner :

1/ compile a list of lines observed as a function of time in the spectrum;

2/ determine accurately the wavelengths of the lines, with the aid of the comparison spectrum.

3/ determine accurately the profiles of selected lines as a function of time, this being done with the aid of calibration plates which were taken for each plate on the same or similar emulsion and given the same developing;

4/ determine accurately the relative intensities of the lines, in particular the Balmer decrement for both the sharp and the broad components and the relative intensities of the forbidden lines. This will be accomplished with the aid of the 3 color photoelectric photometry done by Connelley and Sandage (1958), the 2 color photoelectric and photographic photometry done by Abrami and Cester (1960) and the determination of the relative continuum intensities by Bloch and Dufay (unpublished).

To date we have accomplished the first two of these points for all of the major lines. The results are shown in Table II. The wavelengths for the broad emission lines have no direct application, indicating only the peak intensity wavelength, and will assume more use when the profiles of the lines are discussed. Notice that there are two sharp CaII H and K absorption lines

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(1) Simultaneously at the same observatory photoelectric magnitudes and colors (U, B, V system) were determined (Connelley and Sandage, 1958).

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closely spaced. It would seem at present that one is an interstellar line and the other originates in the cloud surrounding the star. This is deduced simply from the velocity measurements, one having a counterpart of the same velocity in the H and forbidden lines while the other velocity is reproduced only by the NaI lines. This can be confirmed by the relative change of the equivalent width of these two lines with time, which will be done.

We intend to complete point one by searching the tracings for all faint lines which might escape detection on a single tracing but will show up on a comparison of spectra taken on successive days.

Work on point three has proceeded to the extent that tracings have been taken and reduced of the intensity curve of each calibration plate at 100 A intervals or each plate. The profiles of the lines will soon be determined.

Work on point four will begin upon the conclusion of the preceeding point.

After the conclusion of the observational part of the study we will begin on the interpretation. In the first phase of this work we will limit ourselves entirely to the determination of the structure of the material surrounding the nova, i.e. the outer layers of the nova. We will attempt to determine, as a function of time and space, the electron density and temperature, and the relative abundance of elements. To do this we will consider in turn :

a) the forbidden lines of oxygen, nitrogen, and neon, which we have observed. The theory for the formation of these lines is well known (Aller, 1955), but the geometrical interpretation may be difficult;

b) the hydrogen lines. If the lines originate from an optically thin layer their interpretation will be relatively simple. The first step thus will be to determine for which lines and at what period of development of the nova this will be true. It is suspected that this will prove only to be true for the higher Balmer lines and then only at the last period observed.

During the last five years methods have been developed to some extent for treating the optically thick cas, in specifying in a realistic manner the source function. These methods must be perfected and applied to this particular case. We also have particular interest in discussing theoretically the Balmer decrement in the optically thick case.

c) the CaII lines and the HeI lines. This case is similar to hydrogen in that methods are being developed for a realistic treatment of the transfer problem. We will further consider these methods in application to our observations;

d) the forbidden lines of Fe^+. This is a problem which has not yet been attacked theoretically, but has application to many atmospheres (planetary and diffuse nebulae, stars with extended atmospheres).

The problem is to determine collision cross-sections and Einstein A values for one or several simple systems consisting of 4 levels. It is felt that our knowledge of the Fe^+ atom is sufficient at present to make such a theoretical study productive.

Further theoretical work dealing with the cause of the outburst will not be planned before our determination of the structure has advanced much further.

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BIBLIOGRAPHY

ABRAMI, A., and CESTER, B. - 1960 - Mem. Soc. Ast. Italiana, 30, 183.

ALLER, L. - 1955 - Gaseous Nebulae (Chapman and Hall, London).

CONNELLEY, M., and SANDAGE, A. - 1958 - P.A.S.P., 70, 600.

WALLERSTEIN, G. - 1959 - P.A.S.P., 71.

TABLE I

PLATES OF NOVA RS OPHIUCHI 1958

Date	Pacific standard time from noon	Length of exposure	Wavelength range	Mt. wilson plate no.	Dispersion	Calibration
1958		minutes				
July 13	10 : 56	3	3800-5000	xf 3730	40 Å/mm	no
13	11 : 34	8	3800-5000	xd 3731	14	yes
13	12 : 19	30	3800-5000	xd 3732	14	"
13	13 : 16	72	5200-6700	3733	11	"
13	14 : 22	43	3800-5000	3734	14	"
14	8 : 15	30	5200-6700	3735	11	"
14	9 : 00	60	3800-5000	3736	14	"
14	10 : 13	58	6400-8900	xe 3737	22	"
14	11 : 30	63	3800-5000	3738	14	"
15	8 : 00	31	5200-6700	xf 3740	11	"
15	9 : 02	61	3700-5000	3741	14	"
15	10 : 16	63	6400-8900	3742	22	"
15	11 : 29	6	3700-5000	3743	14	no
16	8 : 02	10	5200-6700	3745	11	yes
16	8 : 36	50	5200-6700	3746	11	"
16	10 : 28	148	3700-5000	3747	14	"
16	12 : 57	120	6400-8900	3748	22	"
19	8 : 54	120	3700-5000	3749	14	"
19	11 : 30	122	5200-6700	3750	11	"
19	12 : 52	30	5200-6700	3751	11	"
19	13 : 19	8	5200-6700	3752	11	"
20	7 : 46	10	5200-6700	3754	11	no
20	9 : 30	130	3700-5100	3755	14	yes
20	12 : 39	156	5200-6700	3759	11	"
21	8 : 14	5	4800-6700	Pd 3934	8	"
21	8 : 49	30	4800-6700			
21	9 : 26	30	3700-5000	Pd 3935	8	"
21	10 : 00	5	3700-5000			
22	8 : 48	5	3700-5000	Pd 3936	8	"
22	9 : 12	30	3700-5000			
22	9 : 56	5	4800-6700	Pd 3937	8	"
22	10 : 13	30	4800-6700			
23		5	4800-6700	Pd 3938	8	"
23		30	4800-6700			
23		5	3700-5100	Pd 3939	8	"
23		30	3700-5100			
24		5	4800-6700	Pd 3942	8	"
24		30	4800-6700			
24		5	3700-5100	Pd 3943	8	"
24		30	3700-5100			
27			3700-5000	Pc 3955	4.7	"
29			3700-5000	Pc 3965	4.7	"

EXPLANATION OF SYMBOLS IN TABLE II

<u>a</u> : absorption ; <u>e</u> : emission ; <u>eb</u> : broad emission

Entries in parentheses refer to the plate number in parentheses at the head of the column

Date / Plate / Identification		July 13		July 4	July 5		July 6		July 7			July 20	July 21	July 22	July 23	July 24	July 27	July 27
	λ 3730	λ 3732	λ 3734 (λ 3733)	λ 3736 (λ 3735)	λ 3741 (λ 3740)	λ 3745	λ 3743 (λ 3742)	λ 3744 (λ 3750)	λ 3752	λ 3751	λ 3754	λ 3755 (λ 3756)	Pa 3935 (Pa 3934)	Pa 3936 (Pa 3937)	Pa 3939 (Pa 3938)	Pa 3943 (Pa 3942)	Pa 3955	Pa 3963
H 19																	368977 eb	
H 18																	369113 eb	369131 eb
H 17														369757 eb	369765 eb	369977 eb	370090 eb	370037 eb
H 16							[illegible] a	[illegible] eb				[illegible] eb		[illegible] eb	370369 eb	370339 eb	370379 eb	370375 eb
H 15				371150 a			[illegible] a	[illegible] eb				[illegible] eb		371152 eb	371138 eb	371176 eb	371176 eb	371183 eb
H 14				372145 a			372135 a					[illegible] eb		372179 eb	372159 eb	372150 eb	372142 eb	372164 eb
H 13				373402 a			373419 a	[illegible] eb				373476 eb	373593 eb	373524 eb	373492 eb	373451 eb	373483 eb	373494 eb
H 12		375035 a		374917 a			375036 a	375077 eb				375223 eb	375255 eb	375230 eb	375138 eb	375242 eb	375222 eb	375301 eb
H 11		377042 a		377031 a			[illegible] a	[illegible] eb				377199 eb	377350 eb	377327 eb	377327 eb	377373 eb	377323 eb	377254 eb
H 10	379762 a	379734 a		379758 a	379757 a		379764 a	379935 eb				379932 eb	380015 eb	380038 eb	380001 eb	380049 eb	380044 eb	380079 eb
H 9		383485 a	383480 a	383493 a	383523 a		383526 a	383836 eb				383831 eb	383852 eb	383822 eb	383843 eb	383815 eb	383842 eb	383876 eb
H 8	[illegible] a	388913 a	388911 a	388900 a	388877 a		388871 a	388971 eb				389209 eb	389230 eb	389192 eb	389212 eb	389160 eb	389205 eb	389152 eb
H ε		396935 a	396971 a	396959 a	396944 a		396931 a	397129 eb				397240 eb	397210 eb	397238 eb	397236 eb	397226 eb	397233 eb	397231 eb
H δ		410143 a 410206 e	410098 a 410132 e	410114 a 410157 e	410145 a 410223 e		[illegible] a	410526 eb				410253 eb	410309 eb	410428 eb	410524 eb	410472 eb	410314 eb	410426 eb
H γ		433995 a 434082 e	433968 a 434041 e	433975 a 434059 e	433959 a 434058 e		434030 a	434455 eb				434475 eb	434411 eb	434412 eb	434463 eb	434316 eb	4346.0 eb	434341 eb
H β	486160 e	486142 e	486092 e	486052 a 486134 e	486087 a 486171 e			[illegible] eb				486378 eb	486474 eb		486370 eb	486346 eb	486525 eb	486447 eb
H β													(486499) eb	(486518) eb	(486379) eb	(486521) eb		
H α				(656279) e	(656269) a 656377 e	656277 a 656326 e	(656282) eb	(656255) eb	656423 eb	6564.9 eb	656443 eb	(656273) eb				(656738) eb		
He I			388848 a					388892 a				388812 a	388811 a	388898 a	388809 a	388804 a	388821 a	388802 a
He I		447169 a	447136 a															
He I					(6678 3) e		(6678[illegible]) e	(667812) eb	[illegible] eb						(667826) eb	(668126) eb		
He II																	[illegible] eb	
K (CaII)	393360 a	393303 a 393366 a	393328 a 393317 a	393316 a 393318 a	393380 a		393311 a 393396 a	393368 a 393351 a				393374 a 393363 a	393299 a 393350 a	393298 a 393370 a	393335 a 393334 a	393328 a 393298 a	393326 a 393307 a	393363 a 393312 a

Table II.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]				396199 a	396166 a	396165 a	396186 a	396210 a	396151 a	396193 a
			[illegible]	[illegible]	[illegible]		[illegible]	[illegible]				396841 a	396821 a	396826 a	396831 a	396872 a	396868	396860 a
[illegible]			([illegible]) a	([illegible]) a	([illegible]) a		([illegible]) a	([illegible]) a				(389916) a	(389932) a	(389029) a	(389050) a	(389022) a		
													389012 a					
[illegible]			([illegible]) a	([illegible]) a	([illegible]) a		([illegible]) a	([illegible]) a				(389519) a	(389491) a	(389616) a	(389610) a	(389610) a		
													389624 a					
[illegible]													412263 e					412352 eb
[illegible]					411816 e		411811 e	411818 e				411847 e	411839 e	411839 e	411849 e	411838 e	411840 e	411838 e
[illegible]															423803 e		423767 e	
[illegible]							429638 e	429610 e						429261 eb				
[illegible]							417316 e	417311 e				417319 e	417316 e	417314 e		417322 e	417315 e	417323 e
[illegible]					423331 e		423218 e	423269 e				423307 e	423267 e	423276 e	423275 e	423263 e	423289 e	423296 e
[illegible]							430211 e	430132 e						430126 eb	430280 e	430261 e		430264 e
[illegible]								438191 e				438237 eb	438106 eb	438614 eb		438507 e	438505 eb	438551 eb
[illegible]					441626 e		441660 e	441613 e						441141 eb	441649 e	441776 e	441651 e	441652 e
[illegible]													[illegible] e					
[illegible]													431360 e				431378 e	
[illegible]													441343 e			441328 e	441344 e	441344 e
[illegible]																449067		449073 e
[illegible]							[illegible] e	[illegible] e				451520 e				451480 e	451524 e	451507 e
[illegible]							[illegible] e	[illegible] e				452018 e	451943 e	452054	451988 e	451982 e	452010 e	451995 e
[illegible]					[illegible] e		[illegible] e	[illegible] e				455353 e	455330 e		455569 e	455532 e	455290 e	455573 e
[illegible]					[illegible] e		[illegible] e	[illegible] e				462857 e	462844 e		462906 e	462881 e	462941 e	462921 e
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[illegible]							[illegible] e	[illegible] e				452248 e	452264 e		452221 e			452243 e
[illegible]					[illegible] e		[illegible] e	[illegible] e				454887 e	454865 e		454929 e	454910 e	454946 e	454942 e
[illegible]					[illegible] e		[illegible] e	[illegible] e								458329 e	457593 e	458374 e
[illegible]													(492439) eb	(492462) eb	(492542) eb	(492540) eb		
[illegible]													(501837) eb	(509946) eb	(509160) eb	(509810) eb		
[illegible]														(556439) eb	(556333) eb	(556336) eb		

Table II.

[illegible]													(522[illegible])eb	(523[illegible])e	(523440)e	(523417)e		
[illegible]													(527593)eb	(527251)e	(527592)e	(527569)e		
[illegible]													(5316[illegible])eb	(531641)e	(531651)e	(531619)e		
[illegible]													(535502)eb	(535451)eb	(535476)e	(535411)e		
[illegible]							(641[illegible])e	(645[illegible])e				(645583)e						
[illegible]																398612 e		
[illegible]												424591 e			424541 e		424364 e	424372 e
[illegible]																	424437 e	
[illegible]							428124 e	428631 e				428324 e		428616 e	428634 e	428714 e	[illegible] e	428721 e
[illegible]								443190 e										
[illegible]																	441772 e	441770 e
[illegible]								441519 e					44[illegible] e					441599 e
[illegible]												455159 e	455193 e					
[illegible]															462114 e			
[illegible]								465310 e				465331 e	465328 e					
[illegible]													470064 e					
[illegible]								441386 e				48[illegible] e						
[illegible]								472416 e							495831 e	495842 e	495894 e	
[illegible]															495831 e	495842 e	495894 e	495819 e
[illegible]															500623 e	500636 e	500689 e	500670 e
[illegible]														(495821)e	(495773)e	(495730)e		
[illegible]														(500633)e	(500672)e	(500641)e		
[illegible]								456[illegible] e				456292 e	456263 e	456261 e	456211 e	456274 e	456217 e	456292 e
[illegible]								(515433)e				(515400)e	(515426)e	(515436)e	(515450)e	(515466)e		
[illegible]								386149 e				386153 e	3861[illegible] e	386125 e	386145 e	386148 e	386160 e	386141 e
[illegible]														396702 e	396720 e	396741 e	396713 e	396720 e

Table II.

Unidentified Lines

Date	July 13	July 13	July 14	July 15	July 16	July 19	July 19	July 20	July 22	July 23	July 24	July 27	
Plate	x 5932 (x 5933)	x 5934	x 5935	x 5940	x 5945 (x 5946)	x 5949	x 5950 (x 5951)	x 5955 (x 5956)	Fd 5937	Fd 5938	Fd 5942	Fd 5955	Probable Origin
						446416 e 446534 a		446544 [illegible]				[illegible] e	J II
	449037 a	[illegible]22 a											Ca II
									504[illegible] eb	504144 eb	504185 eb		Si II
					([illegible])e		638352 e	(638252) e					Si II
	579663 a												Interstellar
	(579777)						578101 a		578048 a	578091 a	578060 a		Interstellar
					(628470) a		628433 a			628300 a	628183 a		Interstellar
		627747 a					627804			627930 a	627885 a		Interstellar
	(661316) a		[illegible]325 a	661458 a	(661446) a		(661376) a						Interstellar
							631738 e	([illegible]) e			632022 a		Zr II

Other Lines

Date	July 4	July 5	July 6	July 19	July 20	July 21	July 22	July 23	July 24	July 27	July 28
Plate / Identification	x 5939	x 5942	x 5946 (x 5948)	x 5949 (x 5950)	x 5956	Fd 5934 (Fd 5935)	Fd 5936 (Fd 5937)	Fd 5938 (Fd 5939)	Fd 5942 (Fd 5943)	Fd 5955	Fd 5963
He I			[illegible] a	402552 eb		(402529)e	[illegible] eb	(402375)eb	([illegible]) eb	402754 eb	402954 eb
He I							444438 e	(444560)eb	(444244) eb	444269 e	
He I		[illegible] eb	([illegible])eb								
Fe II + [illegible]						[illegible] eb	([illegible]) eb	[illegible] eb	[illegible] eb		
Fe II + [illegible]				([illegible])e	[illegible] eb				624633 eb		
[illegible] II						567222 eb	(567190) eb	[illegible] eb	[illegible] eb		
C I	[illegible] a eb	[illegible] a eb	([illegible]) a eb								
C I		[illegible] eb	([illegible]) eb								

IMP. LOUIS-JEAN – GAP

Dépôt légal n° 575 – 1961