14. COMMISSION DES ÉTALONS DE LONGUEUR D'ONDE ET TABLES DE SPECTRES SOLAIRES

PRÉSIDENT: M. H. D. BABCOCK, *Mount Wilson Observatory, Pasadena, Cal., U.S.A.*

MEMBRES: MM. Buisson, Burns, Carroll, Evershed, Ch. Fabry, Fowler, Hamy, Meggers, Nagaoka, Newall, Risco, St John.

I. PRIMARY STANDARD

1. At a meeting in 1927 at Sèvres the International Conference of Weights and Measures adopted the red radiation from cadmium as the fundamental standard of wave-length, and adopted a relation between this standard and the metre. Conditions were specified under which the cadmium line is to be produced, and since these differ, in a few details, from those provisionally adopted in 1925 by the International Astronomical Union, it is appropriate to consider a recommendation designed to secure uniformity in procedure.

Since an authoritative copy of the proceedings of the International Bureau of Weights and Measures is not yet accessible, further details of this business will be left for discussion at Leiden. (See Section IV for Summary of Recommendations. See also p. 236).

2. One of the recommendations adopted by this Commission in 1925 called for further comparison of cadmium lamps of the vacuum *tube* type with those of the vacuum *arc* type. Progress in this direction is noted in the work of Brown (*J.O.S.A.* **13**, 183, 1926), who concludes that the difference in the wave-length of the red line in these two sources is less than 0·001 A, which agrees with the results of some previous observers.

II. SECONDARY STANDARDS OF WAVE-LENGTH

1. STANDARD IRON LINES

Since 1925 further studies of the standard iron lines have been published, which confirm and extend the preceding observations. It has been found that the specifications which the Union adopted for producing standard iron lines have resulted in a precisely reproducible source even for highly sensitive lines (see λ4859 in Table I). Striking agreement is shown in the results of different laboratories, particularly in the case of those investigations which conformed most nearly to the procedure recommended by the Union and which also, from the experience of the observers and the amount of measurement carried out, are entitled to the greatest weight. The uncertainty in the final results for iron is only about one part in five millions, which compares very favourably with the case of neon. The evidence which has now accumulated confirms the need for a slight revision of the standard iron wave-lengths adopted in 1922, and the data give strong assurance that if this revision is made further changes will not soon be required.

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press

It is recommended:

(2) That the seven-figure wave-lengths in the first column of Table I, marked "Recommended λ", be adopted as secondary standards to replace the system of iron standards now in use.

Although there is a small amount of dissent, the majority of spectroscopists regard the adopted form of Pfund arc as a satisfactory practical solution of the problem of producing standards of wave-length in the visible spectrum. Further discussion of this question is unnecessary here, except to point out that an examination of the published data for iron, nickel and titanium in both atmospheric and vacuum arcs confirms the conclusion that the vacuum arc offers no advantage sufficient to compensate for its inconvenience and lower luminosity.

Recent progress in the analysis of the iron spectrum and in the study of the pressure effect enhances the usefulness of the system of standards. For most of these lines the difference in wave-length due to a change of pressure of one atmosphere is now known with considerable accuracy.

Although more extensive than the previous list of secondary standards, Table I leaves the region λ5506 to λ6027 without good standards. The interferometer may of course be used for measurement of wave-lengths in this region by referring to standards on either side and making allowance for change of phase in the usual manner. If it is desired to use high-dispersion grating spectrographs for observation here, the solar spectrum may be suggested as a source for standards, provided the necessary precautions and corrections are observed.

Table I provides for most of the visible spectrum and somewhat beyond on one side, but it should be extended in both directions as rapidly as possible. No new measurements are available for fixing standards of shorter wave-length than those in Table I. However, the data permit the determination of refined values for numerous spectroscopic terms belonging to the iron atom, and from these reliable wave-lengths can now be calculated for certain lines. Between λ2858 and λ3236 about 30 such calculated wave-lengths, involving low levels of energy in the atom, are listed in Table II. It is probable that these values are more reliable than any measurements now existing for that spectral region.

A similar procedure is of little use in the infra-red, because most of the iron lines there which are sufficiently intense to be useful as standards involve high energy levels and are diffuse and unstable. Moreover, arithmetical limitations make it more difficult to secure accuracy in calculated infra-red wave-lengths.

It is recommended:

(3) That further measurements be made on the provisional standards in Table II and that further search be made for suitable lines to serve as standards in the infra-red and in the yellow-orange regions and in the ultra-violet below λ2800.

Although most of the strong infra-red lines of iron are unreliable, a few may be suggested for further measurement as possible standards. These are the members of a multiplet, a^5P'–a^5P, designated *D-H* by Walters, and they are scattered through the region λ8327–λ8824. The arc spectrum of cobalt offers some lines which may be useful. The absorption bands of atmospheric oxygen contain some very sharp lines which have been accurately measured, and attention should also be directed to the red and infra-red lines of argon, accurately measured by Meggers and by Meissner. Further observations are to be encouraged.

2. Neon Standards

New measurements on the neon lines have accurately confirmed the adopted wave-lengths. Although it has been shown that nearly all these standards are self-reversed when observed in end-on discharge tubes with instruments of sufficient resolving power, their practical usefulness as secondary standards has not been impaired. An extensive study of their relative wave-lengths has been made by Burns (*J.O.S.A.* **11**, 301, 1925) with light from the side of a capillary 2·5 mm. in diameter, carrying alternating current of about 0·05 ampere. He concludes that the lines have no complexities of structure which interfere with the accuracy of measurement with orders of interference up to 100,000.

It is recommended:

(4) That the secondary standards of neon, adopted in 1922 and 1925, Table III, be retained without change.

3. Standards in the Extreme Ultra-violet

Though the extreme ultra-violet spectra of celestial objects are inaccessible, astrophysicists recognize the continuity of all spectroscopic data in the optical region, illustrated by Bowen's beautiful explanation of the long mysterious nebular lines. In such ways as it can the Union should assist the establishment of international standards throughout the extreme ultra-violet and should endeavour to make these consistent with the standards of longer wave-length. The following discussion was contributed, at the request of the President, by Dr I. S. Bowen:

(a) *Standards now available*

Determinations of standards in this region have been made by Hopfield and Leifson*, Smith and Lang†, and Bowen and Ingram‡.

The first of these, Hopfield and Leifson, used a 50-cm. focus instrument and films. They standardized high orders of 37 *H*, *C*, *N*, and *O* lines against first-order mercury lines. They estimated the probable error of various lines at from 0·05 to 0·15 A. More recent determinations on larger instruments indicate that their errors were considerably less than this.

Smith and Lang made their determinations with a 6-foot focus grating ruled with 30,000 lines to the inch, thus having a dispersion of 4·5 A per millimetre in the first order. They standardized 28 carbon lines with respect to iron standards. In general each of these lines was determined by measuring its position relative to just two iron lines. Since their iron source was the vacuum spark a great many new spark lines and high order extreme ultra-violet lines were superimposed on the iron arc spectrum. This introduced a high probability that certain of the iron standards were blends which might cause rather serious errors as their use of only two standards for each line afforded no check on the presence of such blends. This probably explains the rather large errors of 0·04 to 0·08 A that are present in certain of their lines, notably the groups near 1550 A.

* Hopfield and Leifson, *Astrophys. Journal*, **58**, 59, 1923.
† Smith and Lang, *Phys. Rev.* **28**, 36, 1926.
‡ Bowen and Ingram, *Phys. Rev.* **28**, 444, 1926.

Bowen and Ingram used a 1-metre grating and measured 92 lines in *C*, *N*, *O*, and *Al* with respect to iron standards. Their probable error was estimated at from 0·01 to 0·04 A. Since their calculations were made with the use of an empirical correction curve fixed by a large number of iron lines, the possibility of errors due to the blending of standards was eliminated.

(*b*) *Methods*

The only method thus far used and the only one that seems to offer a very feasible procedure for the immediate future is the Rowland grating method of comparison of high orders of these lines with iron or other standards. Thus far this has been done solely with short-focus instruments and a large field remains for an instrument having a focal length comparable with those in use for visible and near ultra-violet work. Since it is possible to use relatively high orders in this region this method can be made to yield somewhat higher accuracy than is possible in the longer wave-length region. Methods should be developed, however, for the elimination of the well-known errors attendant on this method.

A second method that can be used is that of the Fabry-Perot interferometer with fluorite plates. The figuring of the fluorite plates with the great accuracy necessary for this short wave-length region will doubtless present many difficulties. At best this method can be used only in the upper part of this region, i.e. above 1200 A.

The third possible procedure is the theoretical one dependent upon the calculation of the difference between two spectral terms by adding up the frequencies of several longer wave-length lines. This will probably be possible only in the upper part of this region. Even then it can, in general, only be used to fix the wave-lengths of higher members of series whose intensity is so low as to render them unsuitable for standards.

(*c*) *Elements suitable for standardization*

Since in vacuum spectroscopy it is very difficult to combine two sources either simultaneously or in succession, it is very desirable to choose for standardization elements that can easily be introduced into any source as an impurity or, better still, that often occur as an impurity. Since oxygen and carbon are almost always present in all electrodes they are especially suitable for this purpose. Their only disadvantage is that many of their lines are complex with a structure so fine that they cannot be completely resolved in the first order of a short-focus instrument. Aluminium is also suitable, since it is often used as electrodes for holding other materials. It has a well-distributed set of strong lines in the region from 1350 to 2000 A.

(*d*) *General considerations*

In the study of any spectrum it is in general advisable to determine the wave-lengths of the strong lines in high orders. This is usually done by comparing these high orders directly either with long wave-length lines of the element being studied or with other standardized lines. The wave-lengths thus determined are then amply accurate for use as standards in the determinations of the weaker first-order lines. This procedure is always possible and in many cases easier than the introduction into the source of some comparison element whose lines have been standardized. These considerations decrease to a certain extent the necessity of having very precise standards in this short wave-length region. For the above procedure it would be more useful to have suitable vacuum-spark and discharge-tube sources standardized in the 2000–5000 A region, as arc lines already fixed occur faintly in such sources.

It is recommended:

(5) That the standards of wave-length now in use in the extreme ultra-violet be examined in relation to the standards adopted by the Union, and that, as soon as such action may be warranted, the Union establish a system of ultra-violet standards consistent with those of longer wave-length.

4. General Progress

No attempt is made to include here a *résumé* of recent work on line spectra. Much is in progress, and the emphasis is largely on the discovery and classification of the spectral terms. For example, the arc and spark spectra of titanium, though exceedingly complex, are almost completely accounted for; they confirm the fruitful modern theory of spectra.

Particularly inviting fields are found in the infra-red spectra of elements astrophysically important and in the rare earth spectra in general. The published wave-lengths for many arc spectra are of lower accuracy than is claimed for them. These require repetition with improved methods. In the visible region many existing observations can be brought to accordance with the new system of standards by applying small corrections. For example, a spectrum which has been measured in terms of the iron lines listed in the report of this Commission for 1922 may be revised by subtracting 0·002 A uniformly from all wave-lengths less than λ5506. From λ6000 to λ6700 the amount to be subtracted increases linearly. It is 0·005 A at λ6050 and 0·009 A at λ6678.

Because these corrections are small, special care is required to avoid confusion between the former and the present values of the standards. In publishing their results observers are urged to indicate which reference system they have used, and, as promptly as possible, to adopt the new system.

Two recent books by Professor H. Kayser call for special mention because of their great usefulness to spectroscopists. These are his *Tabelle der Schwingungszahlen*, which facilitates the transfer of data from the scale of wave-lengths to that of wave-numbers and *vice versa*, and his *Hauptlinien der Linienspektra*, which collects an enormous amount of information into most useful form.

III. SOLAR STANDARDS AND TABLES OF THE SOLAR SPECTRUM

1. Solar Standards

Three independent investigations of the solar spectrum have recently been carried out for the establishment of standards of wave-length. One of these is the combined work of Allegheny Observatory and the Bureau of Standards (*Pub. Allegheny Observatory*, **4**, Nos. 7, 8, 9, 1927). It presents the results of extensive measurements with the interferometer on the spectrum of integrated sunlight from λ3592 to λ7142. Wave-lengths are given for 700 solar and atmospheric lines in terms of neon standards and for many of the lines a large number of observations were made. The method and results are discussed at some length.

The other two contributions are offered individually by St John and Babcock at Mount Wilson Observatory. St John used the centre of a solar image 42 cm. in diameter, making simultaneous exposures to this and to a standard iron arc with a high-dispersion plane-grating spectrograph. Many overlapping spectrograms were taken, covering the regions λ3592–λ5546 and λ6024–λ6495. Lack of standard iron lines forced the omission in the orange-yellow region. The precautions taken to avoid systematic errors, the exceptional instrumental equipment, and the amount of accordant data gathered contribute much weight to this investigation.

The work of Babcock was done entirely with the interferometer in three series of observations. For the first of these, λ4500–λ6900, light from the centre of a solar image 17 cm. in diameter was compared with that of a standard iron arc by the method of intermittent exposures. The second was made with integrated sunlight and simultaneous exposures to sun and arc, covering the region λ3710 to λ4500. These two series together contain over 900 lines. The last series, the results of which have been published (*Astrophysical Journal*, **65**, 140, 1927), included over 500 lines between λ6900 and λ8980.

Table IV contains selections from the material common to the three investigations, and is presented as the basis for a system of solar standards of wave-length. The observations made at Mount Wilson have been adjusted to the new wave-lengths of the secondary standards discussed above. The agreement between different observers (see the last three columns of Table IV) is remarkable, particularly when it is recalled that solar lines are somewhat wider than their terrestrial counterparts and that small systematic deviations easily find their way into such work. Between λ3592 and λ6495 there are in Table IV 211 lines for which the range in three determinations is 0·006 A or less. For 140 other lines, extending to λ7122, there are only two determinations but these differ by 0·002 A or less. These 351 lines furnish a reliable reference system from which the wave-lengths of other solar lines may be obtained by interpolation—a process far less exacting than the fixing of standards.

It is recommended:

(6) That the seven-figure wave-lengths in the first column of Table IV, marked "Recommended λ", be adopted as standards of solar wave-length.

Comparison shows that either integrated sunlight or light from the centre of a large solar image may be used when the standards are to be observed. This is confirmed by calculation from the known changes of wave-length and intensity in passing from centre to limb. It would seem unsafe to use a solar image of diameter less than 75 mm. if light from the centre is to be isolated, and, even for larger images, it is important to avoid any systematic error in centring the slit on the image, because of the displacement introduced by a component of the solar rotation. The slit is preferably placed parallel to the axis of solar rotation and kept short in comparison to the diameter of the image. When integrated sunlight is to be used the observer should make certain that the method adopted is valid. Reference may be made to the published descriptions of such work for further details.

When solar standards are being determined in terms of the terrestrial standards the precautions indicated above require attention, but for some purposes they are unimportant. For example, when it is desired to obtain other solar wave-lengths by interpolation between standards already established, light may be taken from any point in the central portion of the disk, except the vicinity of a sun-spot or other recognized disturbance, since the slight displacement due to solar rotation is then so nearly uniform for all solar lines. It should be remembered, however, that the normal relation between solar lines and those due to absorption in the terrestrial atmosphere is definitely changed if the slit is not accurately centred on the disc, and that the spectrum is considerably modified as the limb of the disc is approached.

2. Revision of the Rowland Table

The Rowland Table of Solar Wave-Lengths has long remained the most extensive collection of data on the solar spectrum. In order to take fullest advantage of it, however, a reduction must be made to bring it to the International Scale on which all recent spectroscopic data are expressed, and it is not practicable either to derive or to express such a relation analytically.

An extensive revision of the Rowland Table is nearly completed by St John at Mount Wilson, providing, for each line listed by Rowland, the wave-length in terms of the iron standards adopted by the Union in 1922. A small supplementary table provides for adjustment to the new values of the iron standards, which are now proposed to replace the list of 1922. In addition, a large amount of new information is given, embodying extension and revision of the identification, intensity in sun-spot spectra, classification according to temperature and pressure effects, and excitation potentials. Great effort has been expended to make the work as complete and up-to-date as possible and to exclude errors. Many questions have been met whose answers, to be correct, must depend upon judgment, highly developed through close contact with the problems involved. The wave-length revision, based on much observation at Mount Wilson, is well confirmed by the recently published measurements made jointly by Allegheny Observatory and the Bureau of Standards.

The work of Rowland and his associates has always been held in high regard, but it may be said that the progress of the revision has been accompanied by an increased appreciation of his genius. In a broad sense the revision contains comparatively little of correction; it is chiefly additive.

3. Suggestions

(*a*) Extension of the system of solar standards in both directions is of primary importance. Such work requires co-operative effort in the sense that established methods of observation are to be applied to enough of the same spectral lines so that the results of various laboratories may be combined. In order to assist in the collection of comparable observations, two lists of solar lines are suggested for measurement in Tables V and VI, for the infra-red and ultra-violet, respectively. In selecting these lines consideration was given to intensity, sharpness, apparent freedom from the disturbing effect of close companions, and fairly uniform distribution in the spectrum.

It is recommended:

> (7) That further measurements be made for extending the system of solar standards in both directions, and that in such observations as many as possible of the lines in Tables V and VI be included.

(*b*) Interpolation for the determination of other solar wave-lengths from the standards should eventually be completed for the entire accessible solar spectrum. Such work is already in progress, but, on account of the great amount of labour involved, the co-operation of many observers is desirable. It is probable that many high dispersion spectrograms already collected could be used for this purpose, since no comparison spectrum is necessary.

(*c*) Investigation of the origin of many solar lines is needed. Improved laboratory wave-lengths and further observation of relative intensity in solar and sun-spot spectra, especially in the infra-red, will be helpful.

(*d*) The distinction between faint terrestrial and solar lines is not always sufficiently exact. More observations are needed, in which instruments capable of showing the faintest absorption lines are used to discern which of these lines are certainly displaced by the solar rotation.

IV. SUMMARY OF RECOMMENDATIONS

1. That the Union modify the provisional specifications, adopted in 1925 for the production of the primary standard of wave-length, so as to agree with those adopted in 1927 by the International Bureau of Weights and Measures*.

2. That the seven-figure wave-lengths in the first column of Table I, marked "Recommended λ", be adopted as secondary standards to replace the system of iron standards now in use.

3. That further measurements be made on the provisional standards in Table II, and that further search be made for suitable lines to serve as standards in the infra-red and in the region λ5506–λ6027.

4. That the secondary standards of neon, adopted in 1922 and extended in 1925, be retained without change.

5. That the standards of wave-length now in use in the extreme ultra-violet (λ200–λ2000) be critically examined in relation to the standards adopted by the Union, and that, as soon as such action may be warranted, the Union establish a system of ultra-violet standards consistent with those of longer wave-length.

6. That the seven-figure wave-lengths in the first column of Table IV, marked "Recommended λ", be adopted as standards of solar wave-length.

7. That further measurements be made for extending the system of solar standards in both directions and that in such observations as many as possible of the lines in Tables V and VI be included.

V. TABLES OF WAVE-LENGTHS

1. Table I. Iron arc lines.

The first column contains two classes of numbers, some with seven figures and others with only four. The seven-figure numbers are means of the values in the later columns of the table, and these are recommended for adoption as standards. The four-figure numbers are the integral parts of certain wave-lengths, for which one or more values of the decimal part are given, but which are not recommended for standards, either because of insufficient observations, or, in some cases, because the line belongs to group *d*. In some parts of the spectrum where other lines are not available a few *d* lines have been recommended as standards. For every such case the remarkable agreement between the results from several laboratories shows that the line is suitable for precise measurement and accurately reproducible†.

The fourth column, marked "Revised Interpolated", is derived from the

* Not adopted (see report of meeting of Commission 14, p. 236).

† For further explanation of Table I see p. 237.

report of this Commission for 1922, where, in Schedule v, were collected the results obtained from many laboratories by interpolation between the secondary standards then in use. The summarized results, there marked "Interpolated", have been revised by small subtractive corrections to the same scale as that of the new observations.

The sources from which the other columns are taken are:

Meggers, Kiess and Burns, *Scientific Papers, Bureau of Standards*, **19**, 263, 1924.
Monk, *Astrophysical Journal*, **62**, 375, 1925.
Babcock, *Astrophysical Journal*, **66**, 256, 1927.
Wallerath, *Ann. d. Phys.* **75**, 37, 1924.
Kleinewefers, *Zs. f. Phys.* **42**, 2, 3, 211, 1927.
Burns—unpublished.

Kleinewefers used a 6 mm. 6-ampere iron arc for all wave-lengths greater than λ5624, and his results, even for lines of shorter wave-length, show peculiar deviations from those of other observers. There can be little doubt that his results are influenced by pole effect, and since he used only two thicknesses of etalon and only two planes, with small scale projection of the interference pattern on the slit, numerous possibilities of introducing systematic errors must be admitted. His results are accordingly printed in italics and omitted from the means in most cases.

Both Kleinewefers and Wallerath used a cadmium arc *in vacuo* instead of a cadmium tube, as specified by the Union, for producing the primary standard, and both omit from their papers some relevant details which would have been helpful in discussing their results.

The wave-lengths in all the tables which follow are observed in air at 15° C. and a pressure of 1 atmosphere. In reproducing the iron standards the specifications adopted by the Union should be followed. The arc has its anode below, consisting of a bead of iron oxide supported in the hollowed upper end of a rod of iron or copper at least 10 or 15 mm. in diameter. The cathode is a rod of steel 6 or 7 mm. in diameter having a massive cylinder of brass or copper fitted close to the end, so that only 2 or 3 mm. of the rod protrude. The arc is to be not less than 12 mm. long, preferably 15 to 18 mm. The line-voltage may be 110 or more and the current strength 5 amperes or less. A horizontal central zone at right angles to the axis of the arc not exceeding 1·5 mm. in vertical dimension is to be used.

Increase of line-voltage and protection from air currents are helpful in steadying the arc, especially when the length is great. Commercial Bessemer steel rod is probably the best material for the cathode. The cooling cylinder should be efficient enough to prevent the formation of a pendent drop of oxide on the end of the cathode. A diameter of 4 cm. and axial length of 3·5 cm. may be suggested. The oxide bead on the anode may be 7 or 8 mm. in diameter. If made too small the arc appears less steady. After operating about an hour it is usually necessary to raise the cooling cylinder on the cathode slightly.

2. Tables II and III require no further description.

3. Table IV. Solar Standards.

Similarly to Table I, the first column contains some numbers with seven figures and others with four. The seven-figure numbers are the averages of the separate observations given in the later columns, and are recommended as standards. For the four-figure numbers more observations are desirable, particularly in the green region.

The second column contains the identification of the lines, as given in the revision of the Rowland Table soon to be issued by St John. Rowland's intensities appear in the third column. The remaining columns give the decimal part of the wave-length as found by St John, Babcock, and Allegheny Observatory-Bureau of Standards, respectively.

4. Tables V and VI.

The first column of Table V gives the wave-length found by Babcock with the interferometer. The identification is in part from Rowland but mainly from Meggers. The intensities are from Rowland and Meggers.

The first column of Table VI is derived from Rowland's Table by applying the correction necessary to reduce to the International Scale. The identifications are from St John's revision and the intensities from Rowland.

TABLE I*

Iron Arc Secondary Standards of Wave-Length, measured in air at 15° C. and 760 mm. pressure.

Recom-mended λ	Int.	Group	Revised interp.	M. K. B.	Monk	Babcock	Wallerath	Kleine-wefers	Burns
3370·787	6		·787	·786		·787			
3379	4		·022						
3396	3	b	·980						
3399	6	d	·336	·337		·336			
3401·522	4	b	·522			·522			
3407	7	d	·462			·461			
3413	7	d	·135			·133			
3427	6	d	·121			·120			
3445	4	d	·152	·151	·152	·151			
3458	3	b	·305						
3465·863	6R	a	·863			·862			
3476·705	5r	a	·706			·704			
3485	6	d	·342	·343	·342	·343			
3495	4	b	·290						
3497·844	5r	a	·844			·843			
3506	5	b	·500						
3513·820	5	b	·820	·821	·822	·819			
3521·264	5r	b	·264			·264			
3558·518	5r	b	·518	·517	·517	·518	·520		
3565·381	6R	b	·381			·381			
3576·760	4		·760				·760		
3581·195	8R	b	·195			·196			
3582	4		·201						
3584·663	5		·663			·664			
3585·320	6r	b	·320			·321			
3586·114	5		·114			·114			
3589·107	4	b	·107			·108			
3606	5	d	·681	·683	·683	·682			
3608·861	6R	b	·861			·862			
3617·788	6	b	·788			·788			
3618·769	6R	b	·769			·769			
3621·463	6		·463			·464			
3631·464	6R	b	·464			·465			
3640	6	d	·391	·393	·393	·391			
3647·844	6R	b	·844			·843			

* For explanation of letters in columns 2 and 3 see report of meeting of Commission 14, p. 237.

TABLE I (*continued*)

Recommended λ	Int.	Group	Revised interp.	M. K. B.	Monk	Babcock	Wallerath	Kleinewefers	Burns
3649·508	6		·508			·508			
3651·469	6	b	·469			·470			
3669·523	6	b	·523			·524			
3676·314	6	b	·312	·315	·314	·313			
3677·630	6		·628	·631	·631	·630			
3679·915	5r	a	·915			·915			
3684	5	b	·111						
3687·458	6R	b	·458			·459			
3690	2	b	·730						
3695·054	3	b	·053	·055		·053			
3704·463	5	b	·463	·464		·463			
3705·567	6R	a	·567			·567			
3711	2	b	·225						
3715	2	b?	·914						
3719·935	8R	a	·935			·937			·935
3722·564	6R	a	·564			·563			
3724·380	6	b?	·379	·381	·381	·378			
3727·621	6R	b	·621			·621			
3732·399	6	b	·399			·398			
3733·319	6R	a	·319			·318			
3734·867	9R	b	·867						·866
3737·133	7R	a	·133			·134			·133
3738·308	4	b	·308			·306			
3745	7R	a	·563						
3745	5r	a	·902						
3748·264	6R	a	·264			·264			·266
3749·487	8R	b	·487			·487			·488
3753	6	d	·614	·615	·615	·612			
3756	3	b	·941						
3758·235	7R	b	·235			·234			·235
3760·052	5	b	·052			·050			
3763·790	6R	b	·790			·791			·790
3765·542	6	b	·543			·541			·541
3767·194	6R	b	·194			·193			
3776	2	b	·456						
3787·883	6R	b	·883			·882			
3790·095	4	b	·095			·095			
3795·004	6r	b	·004			·004			
3797·517	5	b	·517			·517			
3798·513	6r	b	·513			·513			
3799·549	6r	b	·549			·549			
3805·345	6	b	·345	·346	·346	·344			
3815·842	7R	b	·842			·842			·843
3824·444	6R	a	·444			·445			
3825·884	8R	b	·884			·884			·883
3827·825	6R	b	·825			·824			
3834·225	7R	b	·225			·224			·225
3839·259	5	a?	·259			·258			
3840·439	6R	b	·439			·439			
3841·051	6R	b	·051			·049			
3843·259	5	b	·259	·261	·261	·258			·258
3846·803	5	b?	·804			·802			·802
3849·969	5	b	·969			·969			
3850·820	5	b	·820		·821	·820			
3856·373	6R	a	·372			·373			·373

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press

TABLE I (*continued*)

Recommended λ	Int.	Group	Revised interp.	M. K. B.	Monk	Babcock	Wallerath	Kleinewefers	Burns
3859·913	7R	a	·913						·913
3865·526	6R	b	·526	·526	·528	·525			
3867·219	3	b	·219			·218			
3872·504	6r	b	·504			·503			
3873·763	4	b	·763	·764		·762			
3878·021	6r	b	·021			·020			
3878·575	6R	a	·574			·574			·576
3884	2	b	·361						
3886·284	7R	a	·284			·284			
3887·051	6r	b	·051			·050			
3888·517	7	b	·517			·516			
3895·658	5r	a	·658			·658			
3899·709	6r	a	·709			·708			
3902·948	7r	b	·948			·948			
3903	3	b	·902						
3906·482	5r	a	·482	·483	·483	·481			
3907·937	3	b	·936	·938	·937	·937			
3910	2	b	·847						
3917·185	5	b	·185			·184			
3920·260	6r	a	·260			·259			
3922·914	6R	a	·914			·913			
3925	3	b	·946						
3927·922	6r	a	·922			·921			·922
3930·299	7R	a	·299			·298			·300
3935·815	4	b	·816	·816	·815	·814			
3940·882	4	b	·883		·882	·880			
3942·443	3	b	·443			·442			
3948·779	4	b	·779			·778			
3956·681	4	b	·681			·680			
3966·066	7	b	·066			·064			
3967·423	4	b	·423			·424			
3969·261	7r	b	·261			·260			
3977	5	d	·745	·744	·744	·743			
3990	1	b	·379						
3997	6	d	·396	·397		·394			
4005·246	7	b	·246			·244			
4014·534	4	b	·534			·534			
4021	5	d	·870	·870	·870	·869			
4031	2	b	·964						
4044	2	b	·614						
4045·815	8R	b	·816			·814			·815
4062	4	b	·446						
4066·979	4	b	·979						·978
4067·275	3	b	·275						·274
4085	2	b	·009						·004
4100	2	a	·741						·738
4107·492	5	b	·493	·492	·491	·492	·494		
4109	4	b	·807						·804
4114·449	4	b	·449						·447
4118·549	6	b	·550	·549	·549	·549			·548
4121·806	2	b	·806						·805
4127·612	4	b	·612						·610
4132·060	7	b	·060			·061			·060
4132	3	b	·903						·900
4134·681	5	b	·682	·680	·680	·682			·680

TABLE I (*continued*)

Recommended λ	Int.	Group	Revised interp.	M. K. B.	Monk	Babcock	Wallerath	Kleinewefers	Burns
4137	3	b	·001						
4143·871	7	b	·871			·871			·871
4147·673	4	b	·673	·673	·673	·674			·672
4154	4	b	·502						
4156·803	4	b	·803	·802	·803		·805		·801
4170·906	2	b	·906						·905
4175·640	4	b	·640	·639	·638	·640	·642		·639
4177	2	a	·597						
4181	6	b	·759						
4184·895	4	b	·895	·894	·894	·895	·896		·894
4202·031	7r	b	·031			·032			·031
4203·987	3	b	·986	·986	·987	·987	·989		
4213·650	2	b	·650						·650
4216·186	4	a	·186						·185
4219·364	5	b	·365	·364	·364		·365		·363
4226	2	b	·424						
4250·790	8	b	·790			·790			·789
4266	2	b	·968						
4267·830	2	b	·830	·831		·829			·829
4271·764	8r	b	·764			·764			·763
4282·406	6	a	·406	·406	·406	·406			·404
4285·445	2	b	·447			·444			·445
4294·128	6	b	·128			·128			·126
4298·040	2		·041	·040					·037
4305·455	2	b	·455			·455			
4307·906	8r	b	·907			·906			·904
4315·087	5	a	·088	·087	·087	·087			·084
4325·765	9r	b	·764			·765			·765
4327	2	b	·099						
4337·049	5	b	·050	·049		·049			·047
4346	2	b	·559						
4351	2	b	·550						
4352·737	4	a	·738	·738	·737	·737			·735
4358·505	2	b	·505						·504
4367	2	b	·581						
4369·774	3	b	·775			·774			·773
4375·932	5	a	·932	·932	·933	·932			·930
4383·547	10R	b	·548			·548			·546
4387	2	b	·897						
4390·954	3	b	·954	·954		·956			·953
4404·752	8r	b	·752						·752
4407	2	b	·714						
4408·419	4	b	·419	·419		·418			
4415·125	8r	b	·126			·125			·124
4422·570	4	b	·571			·570			·569
4427·312	5	a	·312	·312	·313	·311			·310
4430·618	4	b	·619			·618			·618
4435	2	a	·152						
4442·343	5	b	·344			·342			·343
4443·197	3	b	·197			·198			
4447·722	5	b	·722	·722		·721			·721
4454·383	3	b	·384			·383			·382

TABLE I (*continued*)

Recommended λ	Int.	Group	Revised interp.	M. K. B.	Monk	Babcock	Walleräth	Kleinewefers	Burns
4459·121	5	b	·122			·121			·121
4461·654	4	a	·655			·654			·654
4466·554	5	b	·554	·555	·556	·554			·553
4489·741	3	a	·743			·740			·739
4494·568	5	b	·569	·568	·568	·567			·569
4514	2	b	·191						
4517·530	2	d?	·530	·529					
4528·619	7	b	·620	·619		·618			·618
4531·152	5	b	·153	·152	·152	·152			·150
4547·851	3	b	·852	·851	·850	·850			
4587	2	b	·134						
4592·655	4	b	·655	·655	·655	·655			·655
4602	2	b	·006						
4602·944	4	b	·944	·945	·945	·944			·944
4619	4	b?	·295						
4630	3	b	·126						
4632	3	b	·916						
4638	4	b?	·017						
4647·437	4	b	·437	·437	·437	·436			
4654	4	b	·502						
4667·459	4	b?	·459			·459			
4678·852	5	b?	·854	·853		·851			·851
4691·414	4	b?	·415	·414	·414	·414			·411
4707·281	5	d	(·281)	·282	·280	·280			·280
4710·286	3	b	·286	·287	·286	·286	·288		·283
4733·596	3	b	·596	·596	·596	·595	·598		·594
4736	5	d	(·780)	·782	·780	·780			·781
4741·533	3	b	·533	·533	·531		·534		
4745·806	3	b	·806			·805			
4772·817	3	b	·817	·818	·817	·816	·818		
4786·810	3	b	·810			·809			
4788	2		·760						
4789·654	3	b	·654	·654	·655	·652			
4802	2		·884						
4859·748	5	d	(·748)	·748	·748	·747			
4878·218	5	d	(·218)	·219	·219	·217			·217
4903·317	5	d	(·317)	·317	·317	·316			·316
4918·999	8	d	(·998)	·001	·000	·999			·999
4924·776	3	b	·775	·775	·776		·777		
4939·690	3	a	·689	·692	·689		·692		
4966·096	5	d	(·096)	·097	·098	·094			·096
4994·133	3	a	·133	·132	·132	·133	·136		·130
5001·871	5	d	(·871)	·872	·871				
5012·071	4	a	·071	·072	·071	·071			·069
5041	3	a	·074						
5041·759	4	a	·758	·758	·759		·760		
5049·825	5	b	·825	·825	·825	·824			·824
5051·636	4	a	·637			·637			·635
5083·342	4	a	·341	·343	·342	·342			
5098	4	b	·704						
5110·414	4	a	·413	·414	·414	·414			

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press

TABLE I (*continued*)

Recom-mended λ	Int.	Group	Revised interp.	M. K. B.	Monk	Babcock	Wallerath	Kleine-wefers	Burns
5123·723	4	a	·723	·722	·723		·726		
5127·363	3	a	·363	·362					
5150·843	4	a	·843	·843	·843		·844		
5151	3	a	·914						
5166	3	a	·286						
5167·491	8	a	·491	·490	·491	·490		·493	
5168·901	3	a	·901			·899			
5171·599	7	a	·599			·599		*·602*	
5198·714	4	b	·713	·715			·714	·715	
5202·339	5	b	·338	·339	·339	·339	·341	·341	
5216·278	5	a	·278	·277	·277	·276	·280	·280	
5227·192	8	a	·191			·191		·193	
5242·495	3	a?	·494	·496			·496		
5250·650	3	b	·650	·650	·650		·651		
5269	10	a	·538			·541			
5270·360	8	a	·358	·361	·360	·359	·361		
5307·365	2	a	·364	·364			·366		
5328·534	4	a	·535	·532	·534		·537		
5332	2	a	·901						
5341·026	5	a	·026	·026	·026	·025	·027	·027	
5371·493	7	a	·493	·493	·493	·493		·493	
5397·131	6	a	·132	·131		·130		·132	
5405·778	6	a	·778	·778	·779	·777		*·781*	
5429·699	6	a	·699			·699		·698	
5434·527	6	a	·526	·527	·527	·526		·527	
5446·920	6	a	·919			·919		·921	
5455·613	6	a	·613	·613	·612	·613		*·617*	
5497·519	4	a	·520	·520	·519	·518		·520	
5501·469	4	a	·468			·468		·471	
5506·782	4	a	·782	·783	·782	·782		·783	
5569·625	5	d		·627	·625	·624		*·627*	
5572·849	5	d			·850	·848		*·855*	
5586·763	6	d		·764	·764	·761		*·766*	
5615·652	6	d		·653	·652	·650		*·655*	
5624·549	5	d		·551		·548		*·552*	
5658·826	4	d		·827		·825		·833	
5662·525	3	d		·526		·524			
6027·057	2	b	·054	·058	·058				
6065·487	4	b	·487	·489	·488	·486		*·493*	
6127	2	b	·909						
6136·620	4	b	·618	·623	·621	·618			
6137·696	4	b	·696	·697	·695	·696		*·702*	
6157	2	b	·728						
6165	2	b	·362						
6173	2	b	·338						
6191·562	5	b	·562	·564	·562	·561		*·571*	
6200	2	b	·317						
6219	3	b	·284	·287				*·290*	
6230·728	5	b	·728	·730	·728	·727		*·733*	
6252·561	4	b	·561	·562		·559		*·565*	
6254	3	b	·261						
6265·140	3	b	·139	·140	·141			*·143*	
6297	3	b	·796	·800					
6318·022	4	b	·021	·024	·022	·021		*·027*	

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press

TABLE I (*continued*)

Recom-mended λ	Int.	Group	Revised interp.	M. K. B.	Monk	Babcock	Wallerath	Kleine-wefers	Burns
6322	3	b	·689					*·698*	
6335·335	4	b	·335	·338	·335			*·339*	
6344	2	b	·154						
6380	3	b	·746						
6393·605	5	b	·605	·607	·604	·603		*·610*	
6421·355	4	b	·355	·355		·354		*·358*	
6430·851	5	b	·852	·853	·851	·850		*·855*	
6475	3	b	·631						
6494·985	5	b	·985	·987	·985	·983		*·993*	
6518	3	b	·374						
6546·245	5	b	·244	·247	·246	·242		*·246*	
6575	3	b	·021						
6592·919	5	b	·919	·920	·920	·918		*·921*	
6609	4	b	·117						
6663·446	4	b	·446	·447				*·454*	
6677·993	5	b	·992	·994	·991	·993		*·994*	
6750	4	b	·156						

TABLE II

Computed Wave-Lengths of Iron Arc Lines, based on Term Values derived from Table I*.

λ in air at 15° C. and 1 atmosphere pressure.

I. A.	Intensity	Group
2858·896	4	b
2874·172	7	b
2912·158	8	b
2929·007	7	b
2936·904	7r	b
2941·342	8	b
2947·876	5r	b
2953·940	5r	b
2966·898	6R	b
2983·571	4r	b
3021·073	6R	b
3037·389	5r	b
3047·605	6r	b
3057·448	5r	b
3059·086	5r	b
3067·245	5r	b
3075·719	5r	b
3083·742	4r	b
3091·577	4r	b
3100·303	4r	b
3100·666	4r	b
3116·632	5	b
3125·651	6	b
3129·333	4	d
3134·111	5	b
3143·243	2	a
3161·370	2	d
3171·343	4	d
3180·756	4	a
3184·895	4	a
3199·501	6	a
3226·714	1	a
3229·121	4	a
3236·223	5	a

TABLE III

Neon Lines adopted in 1922 and 1925 as Standards.

5852·488	6074·337	6266·495	6532·882	7032·412
5881·896	6096·163	6304·789	6598·953	7173·938
5944·834	6143·062	6334·428	6678·276	7245·165
5975·534	6163·594	6382·991	6717·042	7535·785
6029·998	6217·280	6506·528	6929·466	

* See report of meeting, pp. 237, 238.

TABLE IV

Standard Solar Wave-Lengths.

Measured in air at 15° C. and 1 atmosphere pressure.

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
3592·027	V+	2	·027		·027
3600	Y+	3	·739		·736
3615	Cr Fe	3	·665		·661
3635·469	*Ti* Fe	4	·468		·470
3650·538		2	·538		·539
3661	Fe–	3	·372		·366
3672·712	Fe–	3	·712		·712
3681	Fe	3	·653		·648
3695·056	Fe	5	·056		·056
3710·292	Y+	3	·291	·294	·291
3725·496	Fe	3	·498	·494	·495
3741·065	Ti	4	·065	·065	·064
3752·418	Fe	3	·415	·420	·419
3760·537	Fe	4	·536	·539	·537
3769·994	Fe	4	·994		·993
3781·190	Fe	3	·191	·190	·190
3793·876	Cr Fe	2	·876	·876	·877
3804·015	Fe	3	·014	·017	·014
3821·187	Fe	4	·187		·187
3836·090	Ti+	2	·090	·091	·090
3843·264	Fe	4	·264		·264
3859	Fe	3	·223		·219
3864	CN	3	·306		·302
3873	Fe	4	·767		·764
3885	Fe	4	·519		·516
3897·458	Fe	2	·460	·457	·458
3906·752	Fe V	4	·754	·752	·751
3916·737	Fe	5	·737	·737	·736
3937·336	Fe	3	·337	·335	·336
3949·959	Fe	5	·961	·957	·958
3953·861	Fe–	3	·863	·862	·859
3960·284	Fe	4	·286	·283	·283
3963·691	Cr	3	·693	·689	·690
3977·747	Fe	6	·750	·745	·747
3991·121	Cr–Zr+	3	·123	·121	·120
4003·769	Fe Ce+–Ti	3	·771	·768	·768
4016·423	Fe	2	·427	·422	·421
4029·642	*Fe*–*Zr*+	5	·645	·642	·639
4030·190	Fe	2	·192	·191	·187
4037·121		2	·122	·122	·119
4053·824	Ti+ Fe	3	·823		·824
4062·447	Fe	5	·449	·447	·446
4073·767	*Fe* Ce+	4	·770	·766	·766
4079·843	Fe	3	·846	·843	·841
4082·943	*Mn* V	4	·946	·943	·940
4091·557	Fe	3	·560	·556	·556
4094·938	Ca	4	·940	·936	·938
4107·492	Fe	5	·494	·490	·493
4120·212	Fe	4	·213	·210	·212
4136·527	Fe	4	·528	·526	·527

TABLE IV (*continued*)

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
4139·936	Fe	6	·937	·936	·936
4154·814	Fe	4	·813	·815	·814
4163·654	*Ti*+ Cr–Fe	4	·656	·655	·651
4168·620	Fe	2	·622	·619	·619
4178·859	Fe+	3	·861	·859	·858
4184·900	*Fe*, Cr	4	·900	·902	·898
4191·683	Fe	3	·683		·683
4198·638	V–*Fe*	3	·637	·638	·639
4208·608	Fe	3	·610	·607	·608
4220·347	Fe	3	·347	·346	·348
4233·612	Fe	6	·611	·613	·612
4241·123	Fe–	2	·125	·124	·121
4246·837	Sc+	5	·836	·837	·838
4257·661	Mn	2	·661	·662	·660
4266·968	Fe	3	·969	·969	·967
4276·680	Fe	2	·681	·682	·678
4282·412	Fe	5	·411	·414	·411
4291·472	Fe	2	·473	·472	·471
4318·659	*Ca* Ti	4	·658	·661	·658
4331·651	Ni	2	·652	·652	·649
4337·925	Ti+	4	·925	·924	·927
4348·947	Fe	2	·947	·948	·946
4365·904	Fe	2	·904	·904	·903
4389·253	Fe	2	·254	·254	·252
4398·020	Y+	1	·019	·022	·020
4408	V	2	·208		·204
4416·828	Fe+	2	·827	·827	·829
4425·444	Ca	4	·444	·444	·445
4430·622	Fe	3	·622	·622	·621
4439·888	Fe	1	·889	·888	·888
4451·588	Mn	3	·588	·588	·588
4454·388	Fe	3	·388	·388	·388
4459·755	Cr–*V*	1	·754	·755	·756
4470·485	Ni	2	·486	·483	·486
4481·616	Fe	1	·615		·617
4491	Fe+	2	·407		·410
4502·221	Mn	2	·223	·220	·220
4508·289	Fe+	4	·289	·287	·290
4512·741	Ti	3	·743	·740	·741
4517·534	Fe	3	·534	·531	·536
4525·146	Fe	5	·145	·143	·149
4531·631	Fe	2	·629	·633	·631
4534·785	Ti	4	·785	·786	·785
4541·523	Cr *Fe*+	2	·522	·524	·524
4547·853	Fe	3	·853	·852	·855
4548·770	Ti	2	·770	·769	·772
4550·773	Fe	2	·773	·772	·775
4563·766	Ti+	4	·764	·764	·769
4571·102	Mg	5		·101	·103
4571·982	Ti+	6		·982	·983
4576·339	Fe+	2	·340	·338	·340
4578·559	Ca	3		·558	·560
4587·134	Fe	2	·136	·130	·135
4589·953	Ti+	3	·952	·951	·955
4598·125	Fe	3	·123	·124	·127
4602·008	Fe	3	·009	·006	·008

TABLE IV (*continued*)

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
4602·949	Fe	6	·949	·947	·951
4607·654	Fe	4	·652	·652	·657
4617·276	Ti	3	·276	·275	·277
4625·052	Fe	5	·052	·050	·055
4630·128	Fe	4	·129	·126	·128
4635·853	Fe	2	·853	·852	·855
4637·510	Fe	5	·510	·508	·511
4638·017	Fe	4	·017	·015	·019
4643·470	Fe	4	·470	·468	·472
4647·442	Fe	4	·442	·441	·443
4656·474	Ti	3	·473	·473	·475
4664·794	–Cr Na?	3		·794	·795
4678·172		3N		·173	·171
4678·854	Fe	6	·855	·852	·855
4683·567	Fe	3	·568	·565	·567
4690·144	–Fe	4	·145	·141	·146
4700·162		4	·164	·158	·164
4704·954	Fe	4	·955	·951	·956
4709	Mn	2		·715	·718
4720·999	Fe	2	·999	·996	1·001
4722	Zn	3		·163	·166
4728·552	Fe	4	·553	·549	·554
4733·598	Fe	4	·597	·596	·602
4735·848	Fe	3	·849	·848	
4736·783	Fe	6	·781	·782	·785
4741·535	Fe	3	·536	·533	·537
4745·807	Fe	4	·808	·805	·808
4761	Mn	3	·526	·528	·534
4772·823	Fe	4	·821	·823	·826
4788·765	Fe	3	·764	·764	·766
4789·658	Fe	3	·657	·658	·659
4802·887	Fe	2	·887	·886	·888
4810	Zn	3		·535	·539
4823	Mn	5		·511	·516
4824·143	Cr^+–Fe	3	·143	·141	·145
4832·719	Ni–*Fe*	3	·720	·719	·718
4839·551	Fe	3	·551	·551	·551
4848	–Cr^+	2		·251	·257
4854	Y^+ Fe	1		·869	·875
4859	Fe	4		·748	·751
4870	Cr–Ni	3		·815	·824
4882	Fe	3		·148	·154
4892	Fe	1		·864	·867
4904	*Ni* V	3		·417	·424
4917	Fe	2		·234	·239
4924	Fe	3	·776	·775	·784
4938	Fe	2		·176	·184
4939·694	Fe	3	·694	·692	·697
4946	Fe	3	·391	·396	·401
4950	Fe	2	·109	·110	·117
4953	Ni	2	·211	·211	·217
4962	Fe	2	·577	·574	·583
4966	Fe	4	·096	·091	·102
4967	Fe	3	·902	·902	·909

TABLE IV (*continued*)

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
4973	Ti–Fe	4	·102	·103	·110
4983·260	Fe	3	·258	·261	·262
4994·138	Fe	3	·137	·136	·140
5001	Fe	5	·868	·870	·876
5002·798	Fe	2	·796	·796	·802
5014·951	Fe	3	·951	·948	·954
5028·133	Fe	2	·132	·133	·135
5039	Ti			·964	·968
5049	Fe	6	·828	·826	·834
5060	–Fe	3		·074	·080
5067	–Fe	3		·156	·160
5068	Fe	5	·772	·770	·779
5074	Fe	5	·755	·752	·762
5079·745	Fe	4	·744	·743	·749
5083	Fe	4	·346	·344	·351
5090·782	Fe	5	·780	·780	·787
5099	Ni	2		·936	·941
5109·657	Fe	2	·654	·655	·661
5115	Ni	2		·398	·401
5126	Fe, Co	2		·199	·204
5137	Fe	3	·389	·396	·394
5150·852	Fe	4	·852	·852	·852
5159·065	Fe	2	·065	·063	·067
5173	Ti	2		·749	·752
5185	Ti^{+}	2		·908	·911
5198·718	Fe	3	·716	·716	·723
5210	Ti	3		·392	·396
5217	Fe	3	·398	·396	·403
5225·534	Fe	2	·533	·533	·537
5242·500	Fe	2	·499	·499	·502
5253·468	Fe	2	·466	·468	·471
5263	Fe	4	·311	·314	·318
5273·389	*Fe*–Nd^{+}	2	·388	·387	·391
5288·533	Fe	2	·532	·531	·536
5300·751	Cr	2	·750	·753	·753
5307·369	Fe	3	·368	·369	·370
5322·049	Fe	3	·048	·049	·051
5332·908	Fe	4	·907	·908	·909
5348·326	Cr	4		·326	·327
5365·407	Fe	3	·404	·407	·409
5379·581	Fe	3	·579	·582	·583
5389·486	Fe	3	·484	·487	·487
5398·287	Fe	3	·285	·286	·290
5409·799	Cr	4		·799	·799
5415·210	Fe	5	·209	·209	·215
5432·955	Fe	2	·954	·956	·956
5445·053	Fe	4	·052	·053	·055
5462·970	Fe	3	·970	·969	·971
5473·910	Fe	3	·911	·910	·909
5487·755	Fe	3	·755	·755	·754
5501·477	Fe	5	·477	·477	·477
5512·989	Ca	4		·989	·989
5525·552	Fe	2	·550	·554	·552
5534·848	Fe^{+}	2		·847	·848
5546·514	Fe	2	·512	·514	·516

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press

TABLE IV (*continued*)

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
5560	Fe	2		·220	·217
5576	Fe	4		·099	·104
5590·126	Ca	3		·126	·125
5601·286	Ca	3		·286	·286
5618	Fe	1		·643	·640
5624·558	Fe	4		·557	·558
5641·448	Fe	2		·448	·447
5655·500	Fe	2		·500	·499
5667·524	Fe	2		·524	·525
5679·032	Fe	3		·032	·032
5690·433	Si	3		·433	·433
5701·557	Fe	4		·557	·557
5717	Fe	4		·842	·839
5731·772	Fe	4		·773	·772
5741·856	Fe	2		·856	·856
5752·042	Fe	4		·041	·042
5760·841	Ni	2		·841	·841
5772	Si	3		·150	·156
5783	Cr	3		·868	·871
5797	Si	3		·866	·870
5805·226	Ni	4		·225	·226
5809·224	Fe	4		·225	·224
5816·380	Fe	5		·381	·379
5848	Fe	3		·124	·127
5853·688	Ba^+	5		·687	·688
5857·459	Ca	8		·459	·459
5859·596	Fe	5		·597	·596
5862·368	Fe	6		·368	·368
5866·461	Ti	3		·461	·461
5867·572	Ca	2		·571	·573
5892·883	Ni	4		·882	·884
5898·166	Atm.wv	4		·167	·166
5905·680	Fe	4		·680	·681
5916·257	Fe	3		·257	·257
5919·054	Atm.wv	5	·055	·054	·052
5919·644	Atm.wv	7	·643	·644	·645
5927·797	Fe			·797	·797
5930·191	Fe	6		·190	·192
5932·092	Atm.wv	5		·091	·092
5934·665	Fe	5		·665	·665
5946·006	Atm.wv	3		·007	·005
5948	Si	6		·548	·544
5952·726	Fe	4		·725	·726
5956·706	Fe	4		·705	·706
5975·353	Fe	3	·350	·353	·357
5976·787	Fe	4		·786	·788
5983·688	Fe	5		·688	·689
5984·826	Fe	6		·825	·826
5987	Fe	5		·070	·067
5997	Fe	2		·781	·786
6003·022	Fe	6		·022	·023
6007	Fe	4		·968	·965
6008·566	Fe	6		·567	·565
6013·497	Mn	6		·497	·497
6016·647	Mn	6		·648	·646

Table IV (*continued*)

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
6021	Mn	6		·803	·800
6024·068	Fe	7	·068	·068	·069
6027·059	Fe	4	·060	·058	·058
6042·104	Fe	3	·104	·103	·104
6056	Fe	5	·012	·014	·005
6065·494	Fe	7	·493	·494	·495
6078·499	Fe	5	·499	·499	·499
6079·016	Fe	2	·017	·014	·016
6082·718	Fe	1	·718	·718	·717
6085·257	Ti–Fe	2	·258	·259	·255
6086·288	Ni	1		·288	·287
6089·574	Fe	1	·576	·573	·572
6090·216	V	2	·218	·216	·215
6093·649	Fe	3	·650	·648	·649
6096·671	Fe	3	·671	·669	·673
6102·183	Fe	6	·184	·182	·182
6102·727	Ca	9		·728	·726
6111·078	Ni	2		·078	·078
6116·198	Ni	4		·198	·197
6122·226	Ca	10		·226	·226
6127·912	Fe	3	·914	·911	·912
6128·984	Ni	1		·985	·983
6136·624	Fe	8	·625	·625	·621
6137·002	Fe	3	·002	·004	·000
6137·702	Fe	7	·702	·704	·701
6141·727	*Ba*$^{+}$–Fe	7	·726	·727	·729
6145·020		2		·020	·021
6149·249	Fe^{+}	2		·250	·248
6151·623	Fe	4	·623	·624	·623
6154·230	Na	2		·230	·229
6157·733	Fe	5	·732	·734	·733
6160	Na	3		·753	·750
6161·295	Ca	4		·296	·294
6162·180	Ca	15		·179	·181
6163	Ca	3		·756	·759
6165·363	Fe	3	·364	·363	·363
6166·440	Ca	5		·440	·440
6169	Ca	6		·044	·040
6169·564	Ca	7		·564	·563
6170·516	*Fe*–Ni	6		·516	·517
6173·341	Fe	5	·341	·342	·339
6175·370	Ni	3		·369	·370
6176·816	Ni	5		·816	·816
6180·209	Fe	5	·210	·210	·208
6186·717	Ni	2		·717	·717
6187·995	Fe	4	·996	·996	·994
6191·571	Fe	9	·570	·573	·570
6200·321	Fe	6	·321	·321	·320
6204	Ni	1	·616		·619
6213·437	Fe	6	·437	·438	·436
6215·149	Fe	5	·153	·148	·147
6216·358	V	1		·358	·359
6219·287	Fe	6	·288	·288	·286
6226·740	Fe	1	·739	·740	·740
6229·232	Fe	1	·234	·232	·229
6230·736	*Fe*–V	8	·736	·735	·736

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press

TABLE IV (*continued*)

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
6232·648	Fe	3	·650	·648	·645
6238	Fe^{+}	2	·394	·387	·387
6240·653	Fe	3	·654	·653	·652
6244·476		2		·475	·476
6245·620	Sc^{+}	1		·620	·621
6246·327	Fe	8	·327	·327	·328
6247·562	Fe^{+}	2	·564	·563	·558
6252·565	Fe	7	·567	·566	·562
6254·253	Fe	5	·252	·254	·254
6256·367	*Fe* Ni	6	·368	·368	·366
6258·110	Ti	2		·111	·110
6258·713	Ti	3		·714	·712
6261	Ti	1		·106	·103
6265·141	Fe	5	·143	·141	·138
6270·231	Fe	3	·230	·232	·231
6279·101	Atm.O	3		·100	·102
6279·896	Atm.O	2		·896	·897
6280·393	Atm.O	2		·393	·393
6280·622	Fe	3	·623	·620	·623
6281·178	Atm.O	1		·178	·178
6281·956	Atm.O	2		·956	·955
6283·796	Atm.O	1		·795	·797
6289·398	Atm.O	1		·397	·398
6290·221	Atm.O	2		·222	·220
6292·162	Atm.O	2		·162	·161
6292·958	Atm.O	3		·957	·959
6295·178	Atm.O	3		·178	·178
6295·960	Atm.O	3		·961	·959
6297·799	Fe	5	·800	·801	·797
6299·228	Atm.O	3		·229	·227
6301·508	Fe	7	·511	·509	·505
6302·499	Fe	5	·501	·499	·497
6302·764	Atm.O	2		·764	·764
6305·810	Atm.O	2		·810	·810
6306·565	Atm.O	2		·566	·564
6309·886	Atm.O	2		·885	·887
6315·314	Fe	2		·313	·314
6315·814	Fe	1	·813	·815	·814
6318·027	Fe	6	·029	·028	·025
6322·694	Fe	4	·694	·694	·693
6327·604	Ni	2		·605	·604
6330·852	Fe	2	·851	·854	·852
6335·337	Fe	6	·335	·339	·337
6336·830	Fe	7	·829	·831	·830
6344·155	Fe	4	·153	·156	·157
6355·035	Fe	4	·033	·036	·036
6358·687	Fe	6	·686	·689	·685
6362	Cr, Fe	2	·875	·876	·869
6378·256	Ni	2		·255	·256
6380·750	Fe	4		·749	·751
6393·612	Fe	7	·613	·613	·611
6400·009	Fe	8	·011	·010	·005
6400·323	Fe	2	·321	·321	·326
6408·026	Fe	5	·026	·026	·026
6411·658	Fe	7	·659	·658	·656

TABLE IV (*continued*)

Recommended λ	El.	Int.	St J.	B.	A. O.-B. S.
6419·956	Fe	4	·958	·955	·954
6421·360	Fe	7	·360	·360	·360
6430·856	Fe	5	·857	·856	·854
6439	Ca	8		·082	·085
6449·820	Ca	6		·820	·820
6455·605	Ca	2		·605	·605
6456·391	Fe^+	3	·392	·389	·391
6471·668	Ca	5		·668	·668
6475·632	Fe	2		·631	·632
6481	Fe	3		·878	·875
6482·809	Ni	1		·808	·810
6493·788	Ca	6		·788	·789
6494·994	Fe	8	·994	·993	·995
6498·945	Fe	1		·945	·945
6499·654	Ca	4		·655	·654
6516·083	Fe^+	2		·082	·084
6518·373	Fe	2		·372	·374
6569·224	Fe	5		·224	·223
6592·926	Fe	6		·926	·926
6609·118	Fe	3		·117	·118
6643·638	Ni	5		·639	·638
6663	Fe	3		·446	·451
6677·997	Fe	5		·998	·996
6705	Fe	1		·105	·108
6717·687	Ca	5		·688	·686
6750	Fe	3		·164	·161
6767	Ni	4		·784	·781
6810·267	Fe	3		·266	·268
6828	Fe	2		·596	·600
6841	Fe	3		·341	·344
6843	Fe	3		·655	·658
6855	Fe	3		·166	·169
6858·155	Fe	2		·156	·154
6870·946	Atm.O	8		·946	·945
6879·928	Atm.O	6		·928	·929
6918·122	Atm.O	9		·122	·121
6919·002	Atm.O	9		·002	·002
6923·302	Atm.O	9		·302	·302
6924·172	Atm.O Cr	9		·172	·173
6928·728	Atm.O	4		·728	·729
6929	Atm.O	4		·598	·595
6934·422	Atm.O	2		·421	·422
6959·452	Atm.wv	3		·453	·452
6961·260	Atm.wv	4		·261	·260
6978·862	Fe	2		·861	·862
6986·579	Atm.wv	3N		·578	·580
6988·986	Atm.wv	3		·987	·986
7022·957	Fe	2		·958	·956
7023·504	Atm.wv	2		·503	·504
7027·478	Atm.wv	2		·477	·479
7034·910	–Fe	2N		·910	·909
7122·206	Ni	4		·207	·206

TABLE V

Solar and Atmospheric Lines suggested for further Measurement and later Adoption as Standards.

λ I. A.	El.	Int.	λ I. A.	El.	Int.
7005·903		1	7887·117	Atm.	1
7011·323	Atm. Fe	2	7901·780	Atm.	3
7052·776	Atm.	1	7918·383	Si	1
7068·423	Fe	2	7937·149	Fe	3
7090·390	Fe	2	7945·857	Fe	2
7130·925	Fe	3	7984·343	Atm.	1
7181·509	Atm.	2	8012·940	Atm.	1
7195·044	Atm.	2	8034·293	Atm.	1
7204·306	Atm.	5	8046·056	Fe	2
7216·527	Atm.	2	8085·175	Fe	2
7227·493	Atm.	3	8107·841	Atm.	1
7236·136	Atm.	1	8125·444	Atm.	1
7245·676	Atm.	2	8139·718	Atm.	2
7265·594	Atm.	5	8158·019	Atm.	6
7303·197	Atm.	2	8176·976	Atm.	10
7323·972	Atm.	1	8186·371	Atm.	5
7326·164	Ca	0	8194·835	Na	2
7335·334	Atm.	1	8212·132	Atm.	4
7355·893	Cr	1	8223·990	Atm.	5
7369·208	Atm.	1	8233·905	Atm.	5
7383·722	Atm.	1	8252·727	Atm.	2
7389·391	Fe	2	8272·041	Atm.	4
7393·610	Ni	2	8289·533	Atm.	4
7405·790	Si	1	8300·406	Atm.	3
7411·158	Fe	1	8327·060	Fe	2
7422·286	Ni	1	8329·682	Atm.	3
7445·755	Fe	2	8342·289	Atm.	1
7491·652	Fe	1	8357·041	Atm.	1
7511·030	Fe	2	8367·333	Atm.	2
7525·115	Ni	1	8387·783	Fe	3
7555·608	Ni	2	8426·518	Ti	0
7568·906	Fe	1	8439·583	Fe	0
7583·796	Fe	1	8468·420	Fe, Ti	2
7676·563	Atm.	4	8514·081	Fe	1
7677·618	Atm.	4	8515·121	Fe	0
7682·756	Atm.	3	8556·795	Si?	1
7696·868	Atm.	0	8582·271	Fe	1
7714·309	Ni	3	8611·813	Fe	1
7727·616	Ni	3	8621·619	Fe	1
7742·722	Fe	2	8648·472		2
7780·567	Fe	3	8674·756	Fe	1
7797·587	Ni	2	8688·642	Fe	2
7807·915	Fe	1	8699·459	Fe	1
7832·207	Fe	2	8717·832		0
7849·984		1	8736·043		1

I. A.	El.	Int.
8752·024	Si	1
8763·974	Fe	1
8793·346	Fe	1
8806·768	Mg	4
8824·233	Fe	2

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press

Table VI

Ultra-Violet Solar Lines suggested for further Measurement.

λ I. A.	El.	Int.	λ I. A.	El.	Int.
2990·421	Fe	1	3293·150	Fe	2
2998·815	Cr–	2	3295·825	–Fe+ Mn	6
3005·061	Cr	3	3301·226	Fe	1
3021·067	Fe	3	3318·032	Ti+	6
3035·745		5	3323·753	Fe	3
3046·676	Ti+	5	3333·396	Co	2
3061·825	Co	3	3344·524	*Ca*–La+	2
3070·266	Mn	3	3355·231	Fe	4
3086·788	Co	4	3365·774	Ni	6
3094·898	Fe?–	4	3381·354	Fe	2
3109·334	OH–Cr	3	3389·749	Fe	2
3121·161	V+	4	3396·982	Fe	3
3126·208	Fe–V+	5	3401·531	Fe	3
3140·758	Co OH–Ca	3	3412·350	Co	5
3142·471	Fe–V+	5	3419·705	Fe	2
3152·263	Ti+	5	3425·584		2
3161·775	Ti+	3	3431·587	Co	4
3162·571	Ti+	4	3445·126	–Fe	5
3170·345	Fe+ Mo	2	3450·335	Fe	5
3187·714	V+	2	3455·246	Co–	5
3199·528	Fe	4	3462·359	Fe	1
3210·226	Co–Fe	3	3466·505	Fe	3
3217·393	Fe	2	3477·866	Fe–Ni	4
3225·805	Fe	3	3485·903	Ni	5
3232·291	Ti+	2	3509·126	Fe	2
3243·415	Fe	1	3517·307	V+	3
3254·762	Fe–V V+	5d?	3540·127	Fe	5
3262·289	Fe	3	3549·873	Fe	3
3273·053	Zr+	2	3564·127w	Fe–Co	4
3278·296	Ti+	5	3583·340w	Fe–	5

Harold D. Babcock
President of the Commission

February 1928

https://doi.org/10.1017/S0251107X0001302X Published online by Cambridge University Press