XVIII. *On the Photographic Arc Spectrum of Electrolytic Iron.*

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[Plates 12, 13.]

Contents.

I. Reference to Earlier Work.

Method of Eliminating Impurities.

In the Bakerian Lecture for 1873* I gave an account of my early researches on the spectrum of iron, which had been commenced in 1870, and suggested a possible method of spectroscopically eliminating impurities. I then hazarded the statement that "in cases of coincidences found between the lines of various spectra, the line may be fairly assumed to belong to that one in which it is longest and brighest." The method was illustrated by three plates, one of which showed the long and short

* 'Phil. Trans.,' vol. 164, p. 479.

lines of iron near F; another the spectra of manganese, nickel, Lenarto meteorite, and iron from about G to H; whilst the third was a comparison of the spectra of calcium and barium with the solar spectrum.

The subject was subsequently referred to in communications to the Royal Society,* in 1874; and with regard to the method of treatment for the elimination of lines due to impurities, I remarked: "The spectrum of the element is first confronted with the spectra of substances most likely to be present as impurities, and with those of metals, which, according to THALÉN'S measurements, contain in their spectra coincident lines. Lines due to impurities, if any are thus traced, are marked for omission from the map and their true sources recorded, while any line that is observed to vary in length and thickness in the various photographs is at once suspected to be an impurity line, and, if traced to such, is likewise marked for omission." This work was very laborious, and I appealed "to some other man of science, if not in England, then in some other country, to come forward to aid in the work, which it is improbable that I, with my small observational means and limited time, can carry to a termination."

THALÉN'S *Eye Observations.*

In 1884, THALÉN published a most important paper on the spectrum of iron which surpassed in completeness everything before it.†

He gives a list of 1,200 lines in the arc spectrum of iron which he had observed to be coincident with dark lines in the solar spectrum. His observations were made between the wave-lengths 3996·7 and 7591·3, that is, from near the Fraunhofer line H to A. Between λ3996·7 and λ5159·6, THALÉN determined the wave-lengths of the iron lines by comparison with lines in VOGEL'S map of the solar spectrum.‡ From λ5160 to λ5400 the wave-lengths given in FIEVEZ'S map,§ as well as those due to VOGEL, were utilised. The positions of lines between λ5400 and λ6379 were determined with reference to FIEVEZ'S lines and the lines in ÅNGSTRÖM'S spectrum.‖ From λ6379 to the Fraunhofer line A, the positions were determined by micrometer measures, and a comparison was made with the iron lines mapped by ÅNGSTRÖM in this region.

A Gramme machine, making 900 revolutions a minute, was used by THALÉN to produce the electric arc. Rods of iron, 9 millims. in diameter, were first arranged as poles, but owing to the long time it was necessary to run the current in order to make the observations, the poles got melted. One carbon and one iron pole were then tried, and by taking observations with a long arc, it was found possible to get

* 'Roy. Soc. Proc.,' vol. 23, p. 152; 'Phil. Trans.,' vol. 164, p. 805.

† 'Société Royale des Sciences d'Upsal,' September 26, 1884.

‡ 'Publicationen des Astrophys. Observatorium zu Potsdam,' 1879, No. 3.

§ 'Annales de l'Observatoire Royal de Bruxelles,' 1883, vol. 4.

‖ 'Spectre Normal du Soleil, Upsala,' 1868.

rid of many of the lines due to impurities in the carbon. Observations were also made with iron poles 15 millims. in diameter, but although these did not melt so readily, the results obtained were not deemed satisfactory. Finally iron was volatilised on carbon poles. THALÉN used the best Swedish iron in his investigation, but found that impurities were always present in it, and also in his carbon poles; for the spectrum of the arc always exhibited lines which were known to be due to calcium, manganese, barium, titanium, lithium, sodium, and other substances. In order to distinguish between lines due to foreign substances and those really due to iron, the spectra of suspected impurities were separately examined. Lines common to all or any of the elements observed and to the spectrum of iron on carbon poles, were assigned to the one in whose spectrum they were most intense. The origin of many of the foreign lines was known from the work of previous investigations, and it was therefore often only necessary to make exact determinations of wave-length to decide whether such lines did or did not coincide with lines attributed to iron.

As to the success of this method of eliminating impurities THALÉN remarks:—"Malgré tous les soins que j'ai pris, il est pourtant bien probable que quelques unes des raies attribuées au fer doivent être rejetées de ma liste comme appartenant à des corps étrangers. Néanmoins, après avoir examiné en somme cinq fois le spectre du fer, je suis porté à croire que je peux énoncer comme résultat de ma recherche précédente que le nombre des raies du fer obtenu dans le spectre visible monte réellement au moins à 1200, et que ces raies coincident toutes avec des raies sombres du spectre solaire. Je ne doute pas qu'on ne puisse encore augmenter beaucoup ce nombre, au fur et à mesure qu'on augmente l'intensité du courant, c'est à dire en se servant de machines dynamo-électriques plus puissantes que la mienne."

II. THE PRESENT WORK.

Necessity of the Research.

Observations of the variations undergone by the spectrum of a single element subjected to changes of temperature, led me to make an investigation of the spectra of different strata of the sun's atmosphere. The considerations which made me hope for help in this quarter were stated as follows:—"Whatever be the chemical nature of this atmosphere, it will certainly be hotter at the bottom—that is, near the photosphere—than higher up. Hence, if temperature plays any part in moulding the conditions by which changes in the resulting spectrum are brought about, the spectrum of the atmosphere close to the photosphere will be different from that of any higher region, and, therefore, from the general spectrum of the sun, which practically gives us the summation of all the absorptions of all the regions from the top of the atmosphere to the bottom.

"Now, as a matter of fact, we have the opportunity, when we observe the spectrum

of a sun spot or a prominence, of determining the spectrum of a practically isolated mass of vapours *in the hottest region open to our inquiries*, and seeing whether it is like or unlike the general spectrum of the sun. What then are the facts? . . . . . The whole character of the spectrum of iron, for instance, is changed when we pass from the iron lines seen among the Fraunhofer lines to those seen among the spot and prominence lines; a complex spectrum is turned into a simple one, the feeble lines are exalted, the stronger ones suppressed almost altogether."*

One of the best examples of the changes of intensity of the iron spectrum brought about by changes of temperature is afforded by the group of three lines at wave-lengths 4918, 4919·8, and 4923·2 (ÅNGSTRÖM'S scale). In the solar spectrum, 4919·8 is thickest, in the oxyhydrogen flame none of them is visible, in the electric spark with jar†, *4923·2 is thickest*, while it is almost invisible in the electric arc; under no conditions are all intensified at once, each one seems intensified at the expense of the other. Observations made at Kensington, of the most widened lines in the spectra of spots, show that the lines at wave-lengths 4918 and 4919·8, which are seen almost alone in some photographs of the arc spectrum, are seen alone in the spots, or, at all events, in 73 spots out of 100, and the other line which is enormously expanded when we use the highest temperature, is seen alone in 52 out of 100 prominences by TACCHINI. "Then, we finally learn, that in several cases when a change of refrangibility has been observed in the iron lines in the spots visible on the sun, that the two lines 4918 and 4919·8 have been affected, while 4923·2 has remained at rest."‡ These variations are, I hold, therefore, the result of temperature changes. Messrs. LIVEING and DEWAR, however, deny that the line of the triplet seen in the prominences, and most brilliant at the highest temperature available in our laboratories, is due to iron, although it has been recorded as an iron line, as shown by WATTS, KIRCHHOFF, HUGGINS, THALÉN, LECOQ DE BOISBAUDRAN, and myself. Its quality as an iron line, therefore, is as established as that of any other lines seen in the spectrum. *Quod ubique quod ab omnibus.* In their words, "The line at wave-length 4923, which occurs so often in the chromosphere, according to YOUNG and TACCHINI, and is assumed to be due to iron, is so near to lines which come out in our crucibles on the introduction of other metals, that we cannot help feeling some doubt as to its absolute identification with the iron line."§

Further, a knowledge of the true spectrum of iron is of the utmost importance for the solar and stellar work which is in progress at Kensington. Observations of the lines which are most widened in the spectra of sun spots have been made since 1879,

* 'Chemistry of the Sun,' p. 253.

† The quantity spark employed by Mr. MCCLEAN to obtain the photographs, which are referred to later, approaches almost the conditions of the electric arc. The changes here mentioned, however, depend upon experiments with a high temperature jar spark.

‡ *Ibid.*, p. 351.

§ 'Roy. Soc. Proc.,' vol. 33, p. 432, 1882.

and the preliminary reductions indicate that, at the period of minimum sun spots many of the most widened lines are due to iron, while at maximum the lines are chiefly of unknown origin. A table of iron lines is therefore essential in an inquiry of this nature. The series of photographs of stellar spectra, which have been taken at Kensington, include some stars which resemble the sun, some which differ slightly from it, and others which differ greatly. A comparison of these in terms of iron is very important, and is a natural first step in their study when we have a terrestrial iron spectrum about which there is no doubt.

The necessity therefore got stronger and stronger to get the true spectrum of iron. At this juncture in 1887, in a conversation with my colleague, Professor W. C. ROBERTS-AUSTEN, he informed me that he was preparing some iron of exceptional purity by electrolytic deposition, and that there was a certain quantity of this available for research purposes, which he placed at my disposal.

I at once determined to obtain photographs of the spectrum of this material, using it for both the poles of an electric arc, so that all carbon pole impurities might be avoided.

This paper is the result. Owing to the small quantity of iron available, the exposures were necessarily short, so that in some parts of the spectrum the number of lines is not so complete as is desirable.

THALÉN'S memoir is practically complete, so far as the visible arc spectrum of iron is concerned. The photographic arc spectrum of iron over the same region has not, however, hitherto received such minute attention. I have therefore taken up the subject by photographically comparing the spectrum of iron with the solar spectrum between about K and A, using the electrolytic iron previously referred to. The main advantage gained by photographic comparisons of this character is that a permanent record of the positions of lines relatively to Fraunhofer lines is obtained, which can be referred to at any time, and that the coincidence or non-coincidence of iron lines with solar lines can be easily and exactly determined at leisure by a microscopical examination of the negatives.

Method Employed.

Portions of the electrolytic iron were arranged to form the poles of an electric arc lamp placed about four feet from the slit of a Steinheil spectroscope, having three prisms of 45°, and one of 60°; an image of the arc being formed upon the slit by a suitable lens. The current employed was from a "Victoria" brush dynamo, driven by an "Otto" gas engine, and making about 850 revolutions per minute.

The region between K and A has been photographed on four plates. The first plate takes in the spectrum from about λ3900 to λ4220, the next from about λ4220 to λ4700, a third extends from λ4700 to λ5900, and a fourth from λ5900 to λ7600. The steps are approximately from K to G, G to F, F to D, and D to A of the solar spectrum.

For the region between K and F ordinary Mawson and Swan "Castle" plates were used. But for the parts of the spectrum less refrangible than F specially prepared plates had to be employed. Plates dyed with the following solution were found to give the best results between F and D :—

Erythrosin (1 : 1000)	= 1 oz.
Alcohol	= 1 „
Distilled water	= 8 „
Ammonia (10 per cent. solution)	= 1 „

"Castle" plates were immersed in this bath for two minutes, and were afterwards drained on blotting paper, film outwards, and stood on end to dry. They are then ready for use, and require about the same exposure as is necessary for the blue end of the spectrum with undyed plates.

For the region D to A the plates require different treatment. Two baths are made up as follows :—

No. 1.		No. 2.	
Alcohol	6 oz.	Cyanin (1 : 1000) . .	100 minims.
Ammonia	10 „	Alizarin blue (1 : 1000)	10 „
Distilled water . . .	½ „	Alcohol	6 oz.
		Ammonia	½ „
		Distilled water . . .	10 „

The plate is first placed in No. 1 for a minute, lifted out, drained and placed in No. 2 for the same time; it is then drained and put back in No. 1 for a minute, after which it is dried as before.

Plates treated in this manner give the best results if used the day after preparation; they should never be kept more than three days. The exposure necessary for the red end with these plates is about twelve times that required by ordinary plates for the more refrangible regions of the spectrum.

The ordinary plates and those stained with erythrosin needed no special developers. But in the case of those dyed with cyanin a weak developer is necessary. The one used for the development of a quarter-plate is made up as follows :—

Pyrogallic acid . . .	2 grains.
Ammonium bromide .	¼ grain to 1 oz. of water.
Ammonia	2 minims to 1 oz. of water.

The plate is flooded with this mixture and gently rocked for a few minutes, another minim or two of ammonia is then added, and development continued in the usual manner.

Since the plates dyed with cyanin are sensitive to the red end of the spectrum as well as the blue, they must be prepared and developed in absolute darkness, and it is

only when the development is nearly completed that dim light should be admitted through ruby glass in order to look at a plate.

It was originally proposed to use a Rowland grating for the production of the spectra, especially for the less refrangible portions, where the dispersion is so small. An attempt was made to carry this into effect, but it was soon found that the limited amount of electrolytic iron at my disposal was quite insufficient to permit the long exposure involved, so that prisms were used throughout the length of spectrum photographed. Even when this was done, the want of electrolytic iron prevented the proper exposure being given to the region from D to C, so the photograph of this portion of the spectrum does not contain so many lines as it would have done had more material been available.

Reproductions of the photographs employed in this inquiry are given in Plates 12 and 13.

Reference to the Observations of Messrs. KAYSER *and* RUNGE.

Since my paper was commenced two important memoirs on the spectrum of iron have been published. Professors KAYSER and RUNGE, of the Hanover Technical High School, have investigated the arc spectrum of iron between the wave-lengths 2230·01 and 6750·36 (on ROWLAND'S scale), and compared their positions with those given by THALÉN, CORNU, and VOGEL.* The wave-lengths of the lines in their photographs were determined by micrometric measures, a number of standard lines being used to construct the interpolation curves. The electric arc was produced between poles of wrought-iron, 1 centim. in diameter, and the spectra were obtained by means of a Rowland grating having 14438 lines to the inch. No attempt was made to eliminate lines due to impurities in the iron although metal of the ordinary commercial quality was used. From this it will be seen that Professors KAYSER and RUNGE have gone over very nearly the same ground as I have. But there are one or two important differences in our method of work. They determined wave-lengths by micrometer measures, my positions have been obtained by direct comparison with the solar spectrum. Their object was to investigate the spectrum of iron of ordinary purity, so lines due to impurities are not distinguished from those of iron. My idea has been to obtain the spectrum of the purest iron, and I have indicated in the tables, the lines *possibly* having their origin in foreign substances. I have compared the lines given by Professors KAYSER and RUNGE with those shown in my photographs from λ 3900 to λ 6500. The results are contained in the tables.

Reference to McCLEAN'S *Work on the Spark Spectrum.*

Another paper on the iron spectrum was recently communicated to the Royal Astronomical Society by Mr. F. McCLEAN.†

* 'Abh. d. Akad. d. Wiss. zu Berlin,' 1888.

† 'Monthly Notices, R.A.S.,' vol. 52, November, 1891.

In this case, however, the spark spectrum, and not the "arc" spectrum, was photographed in juxta-position with the solar spectrum. McCLEAN has not tabulated the wave-lengths of the lines exhibited in his photographs, but, from a set of enlargements he has had the goodness to send me, I have been able to determine them with reference to lines in the solar spectrum, in precisely the same way as in my own photographs. The results of this comparison in the region λ 3900–λ 5740 are shown in a separate set of tables.

So far as I am aware McCLEAN has not published any detailed account of the apparatus which he employed.

Explanation of the Tables.

All the lines in the arc spectrum of iron shown on the photographs have been mapped in their exact positions with reference to the lines in Professor ROWLAND'S photographic map of the solar spectrum (first series). In the following tables, however, the wave-lengths have been transferred to the scale of the *second* series. The first and second columns give respectively the wave-lengths and intensities of the lines photographed at Kensington, and the third and fourth those estimated by KAYSER and RUNGE. The lines tabulated in the first column have been taken from the enlarged photographs, of which reproductions are given in the Plates accompanying this paper (Plates 12, 13). A † placed after the wave-length of certain lines denotes that corresponding lines were observed by THALÉN. The first two figures of the wave-lengths are inserted only at the top of each column and where they undergo a change. In each case the scale of intensity used is such that 1 represents the strongest and 6 the weakest lines. The last column is reserved for remarks on the probable origins of lines (generally faint) which appear in the spectrum of iron, but which are possibly due to impurities. An origin stated without further comment signifies that there is a long line at that wave-length in the spectrum of the substance named; but where a ? is added the coincident line of the substance is not one of the longest. Coincidences with lines of cerium have not been considered.

III. DISCUSSION OF THE RESULTS.

Impurities in Electrolytic Iron.

The impurities as indicated (by the method previously referred to) in the appended tables may be summarized as follows:—

Impurities undoubtedly present.—Mn, Ni, Cr, Co, Ba, Sr, Ca, Cu, Ti, Di.
Impurities probably present.—Zr, U, Ru, La, Er, Mo, Zn, V, W, Os, Al.

The evidence for the elements in the first column depends upon the work of others

as well as that at Kensington, but the evidence in the second column rests solely on the new unpublished map which is in course of construction at Kensington.

Comparison with THALÉN'S *Eye Observations.*

The position of all lines, for which the corrections differ considerably from the mean, have been very carefully determined from the scale of wave-lengths attached to ROWLAND'S maps, so that a few slight corrections to some of THALÉN'S measures appear to be indicated. Thus in the region between 4600 and 4700, the mean difference of wave-length on the two scales is + 1·0. On the photographs a strong line occurs coincident with a Fraunhofer line at 4667·6. THALÉN gives the wave-length of this line as 4665·5. The difference is therefore 2·1 instead of about 1·0. It seems probable that a misprint has occurred, and that 4665·5 should be 4666·5, in which case the difference would be 1·1.

THALÉN'S estimation of the intensities of the lines generally agrees with the intensity in the photographs. The lines showing the most striking differences in this respect are 4432·8, 4433·4, and 4434·0. They are given the intensities 4, 3, 4 by THALÉN, in the photographs, however, their intensities are 6, 5, 6.

Some of the single lines given by THALÉN have been found to be double, and a few which he suspected were double have been proved to be so. These cases are shown in the tables.

In all regions, except that contained between K and G, THALÉN observed more lines than are found in the photographs. The number of lines observed in each case, in all the regions contained in the appended tables, are as follows :—

Regions compared.	Lines mapped from the photographs.	Lines observed by THALÉN.
λ 4000–G	257	194
G–F	254	266
F–*b*	120	188
b–D	187	213
D–C	55	147
	Total . 873	Total . 1008

More lines would doubtless have been obtained, in the region from D to C, if a longer exposure had not been prevented by a want of electrolytic iron.

In addition to the photographic lines which appear to be due to impurities in the electrolytic iron, several lines common to THALÉN and the photographs, and some given by THALÉN, but not found in the photographs, most probably require to be eliminated from the spectrum of iron proper. The lines having their origin in

elements other than iron are, in nearly all cases, extremely faint. A list has been made of all the lines observed by THALÉN, which are neither recorded by KAYSER and RUNGE, nor present in the Kensington photographs.

LINES mapped by THALÉN and not mapped by either LOCKYER or KAYSER and RUNGE.

Wave-length (THALÉN).	Intensity.	Probable origin.	Wave-length (THALÉN).	Intensity.	Probable origin.
4069·7	5	Mn.	5056·5	6	
4496·2	5	Cr?	5057·5	6	
4506·5	6		5080·6	6	
4544·0	6	(V or Co)?	5114·6	5	Ni.
4590·1	6		5153·7	6	
4683·7	6		5156·0	6	(Ni or Sr)?
4716·8	6		5209·5	6	Ti?
4754·7	6		5211·0	6	La?
4758·8	6	Ti.	5244·7	6	Mo?
4779·8	6		5294·9	6	
4848·8	5·5		5325·9	6	
4861·7	5		5326·6	6	
4866·6	6		5590·8	6	
4867·6	6		5605·8	6	
4873·0	5·5	Ni?	5634·0	5·5	
4873·7	5		5644·0	6	
4874·3	5·5		5669·1	6	
4896·8	6		5776·0	6	
4897·8	6	Mn?	5800·0	6	
4900·1	6		5825·0	6	
4924·9	6		5827·5	6	
4943·7	6		5884·4	6	
4974·7	6	Ni?	5959·5	6	
4985·3	5·5		6101·7	4	
5024·0	6	Ti.	6183·0	6	
5030·3	6		6185·3	6	
5052·2	6	(W or Ti)?	6303·5	6	
5055·3	6		6306·0	6	
5055·8	6				

Comparison of KAYSER *and* RUNGE'S *Lines and Lines in the Kensington Photographs.*

It appears from the tables that electrolytic iron does not give nearly so many lines as ordinary commercial metal. But the difference in number may be partly due to the use of different temperatures as well as difference of purity. The almost constant difference of 0·1 tenth metre between the two sets of measures is a satisfactory sign of mutual accuracy. As my measures are only carried to the nearest fifth figure, while those of Messrs. KAYSER and RUNGE are carried to six, such differences as those most frequently met with in the tables are only to be expected. All the lines in the regions taken in which the difference appears abnormal have been specially

re-examined; and, as the wave-lengths have been read directly from ROWLAND'S map, there is little chance of error.

Messrs. KAYSER and RUNGE have not attempted, in their first paper on the iron spectrum, to distinguish the lines due to impurities. I have, therefore, endeavoured to trace the origins of the lines which appear in their list but not in mine. Many of these additional lines may possibly be accounted for by impurities, but the majority are not represented at all on the new Kensington maps. As already pointed out, they may most probably be ascribed to iron, the lines not having appeared on the Kensington photographs perhaps on account of insufficient exposure, or possibly by the employment of a different temperature.

Comparison with McCLEAN'S *Photographs.*

A comparison of the lines in McCLEAN'S photographs of the spark spectrum of iron and those in the Kensington arc photographs shows a great similarity between the two, but still there are some differences. Although some of the lines not common to the two sets evidently have their origin in various impurities, others appear to be really due to iron. Most of the lines photographed by McCLEAN in the spark spectrum, but which are absent from the arc spectrum, have been found to be due to impurities; whilst, in general, those present in the Kensington photographs and not in McCLEAN'S have been confirmed by THALÉN or Messrs. KAYSER and RUNGE as having their real origin in iron. Below are appended two lists, in one of which are given the iron lines which appear in the arc and not in McCLEAN'S photographs; and in the other those which are found in his photographs, but are absent from the arc. All the lines in the latter list, however, have been recorded in the arc spectrum, either by KAYSER and RUNGE, or THALÉN.

LINES probably due to Iron which are present in the Arc, but not in McCLEAN'S Photographs.

Wave-length.	Intensity.	Wave-length.	Intensity.	Wave-length.	Intensity.	Wave-length.	Intensity.
3966·9	6	4373·7	5·5	4658·5	6	4938·3	6
3974·6	6	4374·6	6	4666·1	6	4942·7	6
3977·0	5	4376·9	5·5	4680·7	5·5	4952·8	6
3978·6	6	4378·0	6	4681·6	6	4954·8	6
3979·7	6	4384·9	6	4682·3	6	4954·9	6
4009·8	3	4388·1	4·5	4683·7	5·5	4968·8	6
4030·3	6	4390·7	6	4687·5	5	5002·1	2
4049·5	6	4395·2	5·5	4688·4	6	5005·9	2·5
4052·1	6	4409·3	6	4689·6	6	5029·8	6
4053·4	6	4423·3	6	4690·3	5	5044·4	6
4054·0	6	4424·0	6	4711·6	6	5051·8	3·5
4057·7	6	4432·8	6	4712·3	6	5067·3	5·5
4091·7	6	4434·0	6	4714·6	5	5076·5	6
4100·3	6	4437·2	5·5	4721·2	5·5	5145·3	6
4100·9	5	4438·5	5·5	4729·8	6	5180·3	6
4101·4	6	4440·1	6	4740·5	6	5184·2	6
4101·8	6	4440·6	6	4748·3	5·5	5184·8	6
4106·4	5	4441·3	6	4750·2	5·5	5202·5	3
4109·2	6	4447·3	6	4752·6	6	5219·9	6
4110·0	4	4447·9	2·5	4765·6	6	5225·7	6
4123·9	6	4450·5	5	4767·0	6	5242·7	4
4126·0	6	4456·5	5·5	4771·8	5·5	5244·0	6
4127·9	6	4502·8	6	4786·2	6	5247·3	6
4161·7	6	4505·0	6	4788·0	6	5250·4	4
4163·8	6	4509·9	5	4788·9	4	5252·2	6
4168·8	6	4518·5	6	4791·4	6	5253·6	5
4171·8	6	4539·0	6	4799·6	6	5255·2	5·5
4178·2	6	4542·6	5·5	4800·0	6	5275·5	6
4202·9	5·5	4558·3	6	4803·1	4	5315·3	6
4230·0	6	4561·6	6	4807·8	6	5322·3	6
4241·4	6	4566·7	6	4808·8	6	5343·6	6
4244·0	6	4567·0	6	4813·9	6	5349·6	5·5
4258·5	6	4569·0	5	4816·1	6	5365·6	6
4258·8	6	4574·9	5	4818·0	6	5490·0	6
4264·4	5	4580·3	5·5	4824·3	6	5503·3	6
4275·5	4·5	4601·2	6	4827·6	6	5529·4	6
4280·7	5	4602·2	5	4834·7	6	5538·7	6
4286·6	6	4607·8	4·5	4896·6	5·5	5553·8	6
4289·2	6	4615·8	6	4905·3	6	5648·8	6
4292·3	6	4619·0	5·5	4909·5	5·5	5649·3	6
4320·9	6	4630·3	3·5	4911·9	6	5654·1	6
4361·0	6	4634·9	6	4912·2	6	5660·7	6
4366·1	6	4636·1	5	4928·0	5·5	5666·9	6
4368·1	5·5	4651·5	4	4932·2	6	5686·7	4
4373·0	6						

Lines probably due to iron which occur in McCLEAN'S *Photographs, but not in the Kensington Arc Photographs.*

Wave-length.	Intensity.	Wave-length.	Intensity.	Wave-length.	Intensity.	Wave-length.	Intensity.
3914·1	6	4205·3	6	4418·5	6	5428·2	6
3925·2	6	4208·1	6	4421·8	6	5443·5	6
3939·2	6	4233·4	3	4541·7	6	5464·5	6
3940·1	6	4253·4	6	4875·2	6	5583·0	6
3963·8	6	4257·0	6	4913·6	6	5600·3	6
3972·2	6	4283·7	6	5197·8	6	5607·9	6
4105·1	6	4314·1	5	5250·9	5	5623·6	6
4129·3	6	4371·5	6	5375·6	6	5650·9	6
4141·1	6	4377·5	6	5409·3	6	5707·2	6
4146·7	6	4381·0	5	5426·2	6	5714·3	6

In general, the intensities of corresponding lines in the arc and spark spectra closely agree. The more remarkable differences in the intensity of the lines are given in the following table. It will be seen that in the great majority of cases the spark lines are attributable to the air between the iron poles being raised to a state of incandescence, and producing lines in the spectrum due to oxygen and nitrogen. In the others the difference is apparently due to a closely adjacent impurity line which appears in one spectrum and not in the other. These impurities are indicted in the last column of the table.

In comparatively few cases does there appear to be a genuine difference of intensity.

Lines common to McCLEAN'S *Photographs and Arc Spectrum, but differing considerably in intensity.*

Authority.	Wave-length.	Arc Intensity.	Spark Intensity.	Remarks.
L.	3906·6	4	2	
L.	4005·0	6	2	
L.	4041·5	6	1	Air-line and Mn
T.	4069·7	5	2	,, ,, ,, ,,
K. & R.	4076·05	6	1	,, ,,
L.	4119·1	6	4	,, ,,
K. & R.	4153·47	6	3	,, ,,
K. & R.	4186·20	6	4	,, ,,
K. & R.	4190·48	6	2	,, ,,
K. & R.	4233·25	6	3	
K. & R.	4317·10	6	1	Air-line
K. & R.	4319·88	6	1	,, ,,
L.	4348·0	6	1	,, ,,
L.	4351·7	5	1	,, ,,
K. & R.	4417·13	6	1	,, ,,
K. & R.	4426·08	6	3	,, ,,
L.	4433·4	5	1	,, ,,
L.	4447·0	6	1	,, ,,
K. & R.	4465·39	6	4	,, ,,
T.	4506·5	6	2	,, ,,
L.	4581·7	3	5	
L.	4587·3	4	6	
L.	4596·3	5	1	Air-line
L.	4614·4	6	1	,, ,,
L.	4637·7	3	5	
L.	4638·2	3	6	
L.	4643·7	4·5	1	Air-line
L.	4650·2	6	3	,, ,,
L.	4661·7	6	3	,, ,,
L.	4662·2	5·5	3	,, ,,
L.	4668·3	1	3	
L.	4705·1	5	2	Air-line
L.	4705·6	5·5	2	,, ,,
L.	4779·6	6	2	,, ,,
K. & R.	4783·56	4	6	Manganese
L.	4924·1	6	2	
L.	4994·3	3·5	1	Air-line
L.	5003·0	6	4	,, ,,
L.	5007·4	5·5	1	,, ,,
K. & R.	5016·40	6	3	,, ,,
L.	5018·6	5·5	2	
K. & R.	5025·60	6	4	Air-line
L.	5169·2	5	2	Probably Ni
K. & R.	5250·76	3	5	
L.	5316·8	5	2	Possibly Co
L.	5365·1	3	1	
L.	5393·4	3	1	
L.	5400·7	5	2	Probably Cr
L.	5445·3	4·5	2	
L.	5463·2 5463·5	4 4	1	
K. & R.	5534·87	6	2	Air-line
L.	5535·6	5	2	,, ,, and Ba
L.	5543·4	5	3	,, ,,
L.	5679·3	4·5	1	,, ,,
L.	5712·4	4	6	,, ,,

General Conclusions.

In this paper I have given an account of the method employed in mapping the photographic spectrum of carefully prepared electrolytic iron. The region covered by the inquiry extends from λ3900 to λ6500, and the lines are compared with those mapped by THALÉN, KAYSER and RUNGE, and those which appear in MCCLEAN'S photographic map of the iron spectrum.

The comparisons have led to the following general conclusions :—

(1.) THALÉN'S work is, on the whole, strikingly confirmed, the visual spectrum as mapped by him differing but slightly in essential points from that which has been photographed at Kensington.

The principal difference is in the greater number of lines mapped by THALÉN in all regions except that between λ4000 and λ4300, and this is probably to be accounted for by the insufficient exposure of the photographs which was necessitated by the limited amount of material available for the experiments.

(2.) The comparison with the spectrum photographed by MCCLEAN indicates that the experimental conditions employed by him produced a temperature not greatly differing from that of the arc employed at Kensington. There are only a few lines which are not common to the two series of photographs, and these in many cases can with great probability be ascribed to impurities present in one case and not in the other. Further, the apparent differences of intensity between some of the lines which are common, are mostly due to the superposition of the spectrum of air upon that of iron in MCCLEAN'S photographs. In some cases, however, there seems to be a real difference in the intensities of the lines, and this may, with much probability, be ascribed to the slight difference between the temperature employed at Kensington and that employed by MCCLEAN.

(3.) The number of lines mapped by Messrs. KAYSER and RUNGE is considerably in excess of that mapped at Kensington in corresponding regions of the spectrum. The comparison indicates that this is partly due to the fact that the iron employed in their experiments contained a greater number of impurities than that employed at Kensington.

No origins have been traced for many of the lines present in their photographs which do not appear in the Kensington photographs, and some of these may therefore be really due to iron, their absence from the Kensington photographs being due to insufficient exposure or to the employment of a different temperature. The possible origins of 341 of these excess lines in KAYSER and RUNGE'S list have been traced from the Kensington maps of metallic arc spectra.

(4.) The impurities which contribute the greatest numbers of foreign lines to the spectrum are calcium and manganese.

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE.

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
39		39			39		39		
00·6	6	00·64	5				44·82	6	
		02·43	6		45·0	5	45·00	5	
03·0	2	03·06	2		45·2	5	45·22	5	
04·0	5	04·00	3		47·1	6	47·11	5	
		05·64	6	Co ?	47·6	5	47·64	4	
06·6	4	06·58	3		48·2	5	48·23	4	
06·8	6	06·84	5		48·8	3	48·87	3	
		07·58	6				49·25	6	La ?
08·1	5	08·02	4		50·1	3	50·05	3	
		09·40	6	V ?	51·3	3	51·25	3	
		09·78	6		52·8	3	52·71	3	
10·0	6	09·95	4		53·2	5	53·25	4	
10·9	6	10·95	5		54·0	6	53·93	6	
13·7	5	13·74	4				54·78	6	
		14·35	6		55·5	6	55·50	5	
16·8	4	16·82	3		56·1	6	56·05	4	
17·3	4	17·29	3		56·6	2	56·54	4	
18·5	3	18·49	4		56·8	2	56·77	3	
18·7	3	18·74	4		57·2	5	57·17	5	
19·2	5	19·18	5				57·80	6	
20·3	2	20·36	3				58·29	6	Ti ?
		20·93	6				58·48	6	
		21·34	6		60·4	6	60·38	5	
23·0	2	23·00	2		61·2	6	61·24	6	
		25·31	6		61·6	6	61·63	5	Al ?
25·7	4	25·74	4				62·42	6	
26·1	3	26·05	4				62·80	6	Ti ?
28·0	2	28·05	2		63·2	4	63·24	4	
		28·17	6		64·6	5	64·61	5	
29·2	6	29·24	5				65·62	6	
30·4	2	30·37	2		66·2	3	66·16	4	
31·2	6	31·22	5		66·7	3	66·70	4	
32·7	4	32·71	5		66·9	6			
33·2	6	33·01	6		67·5	3	67·51	4	
34·0	1	33·75	3	K (Ca)	68·0	5	68·05	5	
		34·47	6		68·5	1	68·55	4	H (Ca).
		34·81	6		69·3	1	69·34	2	
35·4	6	35·40	5		69·8	5	69·72	6	Cr ?
36·0	3	35·92	3				70·35	6	
37·4	5	37·42	4		70·5	4	70·51	4	
		38·16	6		71·5	3	71·41	3	
		38·59	6				73·00	6	Di ?
		40·14	6		73·8	4	73·75	4	
41·0	4	40·98	3				74·10	6	
41·4	6	41·40	5		74·6	6	74·46	6	
42·5	3	42·54	3		74·9	6	74·81	6	
43·5	6	43·43	5				75·33	6	Co ?
44·2	6	44·11	5	Al ?			76·00	6	Mn ?

TABLE I.—Comparison of Lines Photographed with those given by KEYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
39		**39**			**40**		**40**		
		76·47	6				15·40	6	W ?
76·8	4	76·71	5		16·6	6	16·55	6	
77·0	5	76·95	6		17·3 †	4	17·23	4	
		77·66	6	Mn ?	18·2 †	6	18·21	6	Mn ?
77·9	2	77·83	2				18·36	5	Mn ?
78·6	6	78·55	6				18·79	6	
		78·91	6	Co ?			19·13	6	W ?
79·7	6	79·73	6				19·75	6	Co
		81·21	6				20·54	6	
81·9	3	81·87	3				21·69	6	
		83·47	6		22·0 †	3	21·96	3	
84·1	2	84·08	3				22·25	6	Th ?
85·5	5	85·46	4				22·80	6	Cu
86·3	3	86·27	3				23·51	6	Co ?
89·9	6	89·94	5		24·2	6	24·20	6	
90·5	5	90·48	4		24·9 †	5	24·86	4	
94·2	5	94·22	4				25·93	6	U ?
95·4	6	95·34	6	Co ?			27·63	6	Co
96·1	4	96·08	4		29·8	6	29·72	5	
		96·42	6		30·3	6	30·26	6	
97·1	5	97·06	5		30·6 †	3	30·60	4	
		97·25	6		30·9	6	30·84	3	Mn
97·5	2	97·49	3				31·33	6	
98·2	2	98·16	3		32·1 †	5	32·06	4	
		98·76	6	Ti ?			32·54	6	
					32·8 †	5	32·72	5	
40		**40**			33·2 †	6	33·16	3	Mn
					34·6 †	4	34·59	3	Mn
00·4	6	00·36	6				35·76	5	Mn
00·6 †	6	00·57	5		38·9	6	38·83	6	
01·8 †	6	01·77	4		40·2 †	6	40·12	6	
		02·77	6	Ti	40·8	5	40·74	4	
03·9	6	03·88	5		41·5 †	6	41·44	4	Mn ?
05·0	6	04·96	6		44·1 †	4	44·00	4	
		05·07	6		44·7 †	4	44·69	4	
05·4 †	2	05·33	2		46·0 †	1	45·90	1	
06·4 †	4	06·39	5				47·40	6	K ?
06·8	4	06·71	5		48·8 †	5	48·82	5	Mn
07·4 †	4	07·36	4		49·5	6	49·40	6	
		08·97	6	W or Ti			49·92	6	U ?
09·8 †	3	09·80	3				50·83	6	Cu ?
		11·05	6	Cu ?	51·5	6	51·40	6	
		11·49	6	Mn	52·1	6	52·03	6	
		11·81	6				52·43	6	
		13·75	6		52·6 †	6	52·56	6	
14·0 †	6	13·91	4				52·75	5	
		14·41	6		53·4	6	53·31	6	
14·7 †	4	14·63	3		54·0	6	53·87	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
40		40			40		40		
		54·25	6	Yt ?			81·67	6	Mo ?
55·0 †	4	54·94	5		82·2	6	82·20	5	
55·2	4	55·12	5		82·6	6	82·55	5	Co
		55·63	4	Mn			83·03	4	Mn
		56·04	6		83·7	6	83·70	4	Mn
		56·61	6		83·9	6	83·90	4	Mn
55·7 †	6	57·43	4		84·6 †	4	84·59	2	
58·0	6	57·91	3	Cr or Pb	85·1 †	4	85·07	3	
58·4 †	6	58·30	4		85·4 †	4	85·38	3	
58·9 †	6	58·86	4				86·06	6	
		58·99	6	Mn or Ta			86·54	6	Co
59·8 †	6	59·80	4		87·2 †	6	87·16	5	
		60·88	6				87·50	6	
		61·24	6	Di			87·95	6	
		62·00	6	Mo or Pb	88·7	6	88·65	6	
62·6 †	3	62·51	2		89·4	6	89·28	4	
		62·94	6				90·17	6	Mn ?
		63·40	4				91·12	4	
63·7 †	1	63·63	1				91·34	6	
		64·55	5	Ti ?	91·7	6	91·66	4	
65·5	5	65·48	4				92·11	6	Di ?
		65·87	6	La ?	92·5	6	92·43	4	Co ?
		66·29	6	Mn	92·6	6	92·60	4	Ca ?
		66·66	4	Os ?			93·28	6	
67·1 †	4	67·04	3				94·57	6	Ca ?
67·4 †	4	67·36	3				95·35	6	Mn
68·1 †	4	68·07	2		96·1 †	4	96·06	2	
69·2	6	69·08	6				96·67	6	
70·9	4	70·85	3		97·2	6	97·19	6	
71·9 †	1	71·79	1		98·3 †	4	98·26	2	
72·7	6	72·62	5				99·04	6	Ca
		73·35	6				99·87	5	Di ?
73·9 †	5	73·84	4						
		74·49	6	W	41		41		
74·9 †	4	74·87	3						
		76·05	6	Cu ?	00·3	6	00·26	4	
		76·32	6	Co	00·9 †	5	00·82	3	
76·7 †	2	76·72	2		01·4	6	01·37	4	
		77·36	6	Co	01·8	6	01·76	5	
77·9	6	77·74	6	Sr			02·50	6	
78·5 †	5	78·41	3	Ti ?			03·44	6	
		78·83	6		04·3 †	5	04·20	3	
		79·32	5	Mn			04·70	6	
		79·50	5	Mn			05·04	6	
80·0 †	5	79·91	3				05·28	5	Mo ?
80·3 †	5	80·30	4		06·4 †	5	06·37	4	
		80·96	5	Cu ?			06·55	4	
		81·35	6	?	07·7 †	3	07·58	2	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
41		**41**			**41**		**41**		
		08·23	6		34·0 †	6	33·96	4	
09·2	6	09·23	4				34·50	5	
10·0 †	3	09·88	2		34·9 †	3	34·77	1	
		10·41	6				35·43	6	
		11·17	6	Mn			35·98	6	Os ?
		11·85	5				36·58	6	
		12·47	5	V ?	37·2 †	3	37·06	2	
13·1 †	5	13·08	4				37·66	6	
		13·52	6	Mn ?			38·15	6	Os ?
		13·89	6	Di ?			38·99	6	
14·6 †	4	14·53	3		40·1	..	39·96 †	5	
		14·98	5	(V or U) ?			40·54	5	
		15·34	5				41·11	6	
		15·78	6				41·51	6	Mn
		16·22	6		42·0 †	6	41·94	5	
		16·86	6				42·31	6	
		17·41	6		42·8	6	42·74	5	
		17·75	6		43·6 †	1	43·50	1	
		18·00	5	(W or V) ?	44·0 †	1	43·96	1	
18·7 †	2	18·62	1				44·72	6	
		19·00	5	Co ?	45·3	6	45·29	6	
		19·45	5	V ?	46·2 †	6	46·12	4	
		19·84	6				46·70	6	
20·4 †	5	20·28	3		47·9 †	4	47·74	2	
		20·59	6		49·5 †	5	49·44	3	
		21·48	6	Co	50·5 †	6	50·42	4	
22·0 †	5	21·88	3				51·34	6	
22·7 †	5	22·59	3				52·04	5	
		23·16	6	Mn ?	52·3 †	5	52·25	4	
23·9 †	5	23·81	4				52·78	6	
		24·35	6				53·47	6	V ?
		24·76	6	Os ?	54·1 †	3	54·04	3	
		25·17	6		54·7 †	3	54·57	3	
		25·71	5		55·0 †	3	54·95	3	
26·0	6	25·94	5				56·13	6	Di ?
26·4 †	5	26·25	4		57·0 †	3	56·88	2	
		26·95	6	Cr ?			57·46	6	
27·8 †	3	27·68	3		58·0 †	4	57·91	3	
27·9	6	27·86	5		59·0 †	4	58·89	3	
		28·91	6	Rh ?			59·36	6	Ti ?
		29·28	6				60·31	6	(Os or La)?
		29·71	6				60·59	6	
		30·08	6		61·2	6	61·13	5	Zr ?
		30·58	6		61·7 †	6	61·57	5	
		31·14	6	Mn			62·19	6	Co ?
32·2 †	1	32·15	1				62·63	6	Mo ?
33·1 †	4	32·96	2		63·8 †	6	63·74	5	
		33·67	6				64·89	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
41		**41**			**41**		**41**		
65·6 †	6	65·51	5				92·22	6	
		67·38	6	(Ru or Ba) ?			92·62	6	La ?
68·1 †	6	67·96	6				93·35	6	
		68·33	6				93·70	6	
68·8	6	68·71	6				94·56	5	
69·1 †	6	69·03	5		95·5	4	95·46	3	
70·0	6	69·90	6	Ti ?	95·8 †	4	95·71	5	
		70·42	6		96·4 †	4	96·31	3	
71·1 †	4	70·99	2		96·7 †	4	96·66	5	
71·8	6	71·79	5				97·32	6	
		71·99	6	(Ca or Cr) ?	98·5 †	1	98·42	1	
72·3 †	4	72·20	2				98·75	5	
		72·66	6		99·3 †	1	99·19	1	
72·9 †	5	72·81	3						
		73·39	4		**42**		**42**		
73·7 †	5	73·52	6						
74·1 †	5	74·00	4		00·2	6	00·01	6	U ?
		74·47	6		01·2 †	5·5	01·01	4	
75·1 †	5	74·98	3				01·31	6	
75·8 †	3	75·71	2		02·2 †	1	02·15	1	
76·8 †	4	76·62	3		02·9	5·5	02·85	5	
		77·16	6				03·27	6	
77·8 †	5	77·66	3				03·63	6	Cr ?
78·2	6	78·11	6		04·2 †	2	04·07	3	
		78·64	6				05·12	6	
79·1	6	78·95	6		05·7 †	6	05·63	5	
		79·46	6	(Cr or Ca) ?	06·9 †	5	06·78	5	
		79·93	6		07·3 †	5	07·22	4	
		80·60	6	La ?			07·93	6	
		81·16	6		08·8 †	5	08·71	4	
81·9 †	2	81·85	2		10·5 †	2	10·48	2	
82·6 †	5	82·46	3				12·61	6	
		82·85	6				13·38	6	
		83·11	6		13·8 †	4	13·75	4	
		84·31	6		15·7	4·5	15·52	4	Sr ?
85·1 †	3	84·99	2				16·08	6	
		85·72	6		16·4 †	4	16·28	3	
		86·20	6	Mo ?	17·7 †	4	17·69	3	
87·2 †	1	87·17	1				18·48	6	V ?
88·0 †	1	87·92	1		19·6 †	3	19·47	2	
		88·66	6				19·99	6	
		88·99	6	Mo ?	20·5 †	5	20·44	4	
		89·67	5				21·36	6	
		90·07	6	Mn	22·4 †	3	22·32	2	
		90·48	6				23·40	6	Di ?
		90·89	6	Co	24·4 †	4	24·27	3	
91·6 †	1	91·57	1		24·7 †	6	24·63	5	
		91·72	6		25·6 †	4	25·61	3	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
42		42			42		42		
26·2 †	5·5	26·08	4				56·00	6	
26·6 †	6	26·52	4				56·32	6	Ti ?
26·9	6	26·84	4	Ca			56·82	6	
27·6 †	1	27·60	1				57·18	6	
		28·98	6				57·80	6	Mn
29·7 †	5·5	29·61	5		58·5 †	6	58·43	5	
30·0	6	29·86	6		58·8 †	6	58·75	5	
		30·36	6		59·2	6	59·06	5	Cu ?
		30·75	6				59·39	6	Mn ?
		31·32	6				59·63	6	
		32·57	6		60·2	1	60·21	6	
		32·93	6		60·7 †	1	60·64	1	
		33·25	6				61·48	5	Mn ?
33·8 †	2	33·76	1		64·4 †	5	64·37	5	
		34·51	6				64·88	6	
		35·01	6		65·4 †	6	65·37	5	
		35·41	5	Mn			66·09	6	Mn
36·1 †	2	36·09	1				66·69	6	
		36·84	6		67·2 †	5	67·08	4	
37·4 †	5	37·26	5		68·0 †	4	67·97	3	
38·2 †	4·5	38·14	4		69·0 †	5	68·87	4	
39·0 †	3	38·98	2				69·50	6	
40·0 †	4	39·90	3	Mn	70·0	6	69·89	6	La ?
40·6	5	40·50	5	Ru ?			70·13	6	
		40·79	6	Cr ?			70·65	6	
41·3 †	6	41·20	6		71·3 †	1	71·30	1	
		41·90	6	Co ?	72·0 †	1	71·93	1	
		42·44	6	W ?			72·61	6	
42·8 †	5	42·85	5				73·16	6	Cr ?
43·6 †	5	43·44	5		74·1 †	6	73·99	6	
44·0 †	6	43·89	6				74·87	5	Cr
		44·38	6		75·4 †	4·5	75·27	6	
45·5 †	3·5	45·39	3				75·79	6	Cu ?
46·3 †	5	46·18	4		76·8 †	6	76·80	5	
		46·60	6				77·34	6	Mo ?
47·6 †	2	47·60	2		77·8 †	6	77·80	6	
48·4 †	5	48·35	4		78·4 †	5·5	78·35	5	
		48·77	6				79·01	6	
		49·07	6		79·7 †	6	79·59	6	
50·3 †	1	50·28	1		79·9 †	6	79·99	6	
51·0 †	1	50·93	1		80·7 †	5	80·68	6	
		52·27	6	Co ?			81·24	6	Mn
		53·25	6				81·86	6	
		53·89	6		82·6 †	2	82·58	1	
54·1 †	6	54·13	6				83·20	6	Ca
		54·45	5	Cr			83·35	6	
55·2 †	6	55·08	6				83·73	6	
55·6 †	6	55·64	5				84·20	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
42		**42**			**43**		**43**		
		84·55	6	Mn ?			11·12	6	Zr ?
		84·90	6	Ru ?			12·28	6	
		85·20	6				13·91	6	
85·6 †	4·5	85·57	3				14·43	6	
		86·02	6	Co ?	15·2 †	1·5	15·21	1	
		86·22	6				15·83	6	
86·6 †	6	86·58	6				16·21	6	
87·2 †	6	87·05	5				17·10	6	Ti ?
88·3 †	5	88·25	4				18·22	6	
89·2 †	6	89·08	5		18·8	5	18·78	6	Ca
89·5	5			Ca			19·88	6	
		89·84	5	Cr ?	20·9 †	6	20·89	6	
90·1	6	90·04	6	Cr	22·0 †	5	21·90	5	Ti ?
90·5 †	5	90·50	5				22·93	6	
91·1 †	6	90·99	6				24·66	6	
91·6 †	5	91·69	4				25·19	6	(Cr or Ti) ?
92·3 †	6	92·36	5		26·0 †	1	25·92	1	
		92·49	6		26·9 †	6	26·86	6	
		93·07	6	(Mo or Ru) ?	27·3 †	4·5	27·22	4	
		93·61	6		28·1 †	5	28·02	5	
94·3 †	2	94·26	1				28·91	6	
		95·08	6	W ?	31·1 †	6	31·02	6	
		94·45	6	U ?			31·89	6	Ni ?
		95·83	6	(Ti or Cr) ?			33·88 †	6	Ni ?
		96·13	6				35·96	6	Mn ?
		96·56	6		37·2 †	2	37·14	1	
		97·46	6	(Cr or Ru) ?			37·71	6	(Cr or Mn) ?
98·2 †	4	98·16	4				38·05	6	Ti
99·4 †	1	99·42	1		38·4 †	5·5	38·38	5	
							40·21	6	
							40·65 †	6	
43		**43**			43·4 †	5·5	43·39	5	
		00·29	6	Mn ?	43·9 †	5·5	43·81	5	
01·0	6	00·86	6				44·62	6	Cr ?
		01·16	6	Ti			45·17 †	6	
02·4 †	4·5	02·31	5		46·8 †	5·5	46·66	4	
02·7	4·5	02·68	6	Ca			47·34	6	
03·3	6	03·25	6	Di	48·0 †	6	47·99	5	
		03·87	6				48·57	6	
04·7 †	6	04·66	6		49·1 †	6	49·07	5	
		05·32	6				49·87	6	
05·6 †	4	05·58	3				50·43	6	Ba ?
		06·11	6	Ti			51·11	6	Cr ?
		06·80	6		51·7 †	5	51·67	4	
08·1 †	1	07·96	1				52·57	6	
09·2	4·5	09·14	5		52·9 †	2·5	52·86	2	
09·6 †	4	09·50	3				53·60	6	
10·6 †	6	10·52	6				56·94	6	Co ?

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
43		**43**			**44**		**44**		
58·7 †	4	58·62	4				02·95	6	
61·0 †	6	60·91	6				03·60	6	
		62·47 †	6	U ?	05·0 †	1	04·88	1	
66·1 †	6	66·02	6				06·07	6	U ?
		66·89	6				06·74	6	U ?
67·8 †	4	67·68	3		07·8 †	3·5	07·80	3	
68·1 †	5·5	68·00	5		08·6 †	3·5	08·54	3	
		68·67	6	V ?	09·3	6	09·25	6	
		69·18	6	Mn ?			11·12	6	Di ?
69·9 †	3	69·89	2				12·15	5	Mn ?
		70·59	6				13·35	6	
		71·09	6	(Co or Cr) ?			13·99	6	Cr ?
		71·51	6				14·56	6	
73·0 †	6	73·10	6		15·3 †	1	15·27	1	
73·7 †	5·5	73·67	5				16·10	6	
74·6 †	6	74·59	6				16·56	6	
		75·06	6	Mn ?			16·85	6	V ?
76·1 †	3·5	76·04	2				17·13	6	
76·9 †	5·5	76·89	5				18·43	6	
		77·46 †	6				21·37	6	
78·0	6	77·94	6				22·02	6	
78·5	6			Cu ?	22·7 †	3	22·67	2	
		79·36	5		23·3 †	6	23·29	6	
		80·60	6		24·0 †	6	24·01	6	
		82·88	5	Mn ?			24·26	6	
83·7 †	1	83·70	1				25·79	6	Ca
		84·38	6				26·08	6	Ti ?
84·9 †	6	84·82	5				26·74	6	
85·6 †	6	85·40	6		27·5 †	2·5	27·44	2	
		86·70	6				28·17	6	
88·1 †	4·5	88·01	4				28·74	6	V ?
88·6 †	4	88·57	3				29·44	6	V ?
89·4 †	5·5	89·35	5		30·4 †	6	30·32	5	
		90·10	5	(Ru or Ir) ?	30·8 †	3·5	30·74	2	
90·7 †	6	90·59	6				31·43	6	
91·2 †	4·5	91·09	3				32·06	6	
		91·68	6		32·8 †	6	32·68	5	
		91·95	6	Co	33·4 †	5	33·32	3	
92·8 †	6	92·66	6		34·0 †	6	33·98	5	
95·4 †	5·5	95·39	5		35·2	5	35·27	4	Ca
		96·76	6		35·9	6			Ca
		98·84	6				36·50	6	Mn ?
					37·2 †	5·5	37·04	5	
44		**44**					37·88	6	
					38·5 †	5·5	38·50	5	
		00·02	6				39·40	6	
		00·72	6	U ?	40·1 †	6	39·96	5	
01·5 †	4	01·46	3		40·6 †	6	40·56	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
44		44			44		44		
41·2 †	6	41·10	6				74·13	6	
		41·80	6				74·87	6	Ti ?
42·5 †	2	42·46	2				75·41	6	V ?
		42·97	6		76·2 †	1·5	76·20	1	
43·4 †	3	43·30	2				76·98	6	
		44·15	6				77·37	6	
		44·79	6	U ?			77·71	6	(Co or U) ?
		45·15	6				78·18	6	
45·6 †	6	45·61	6		79·8 †	5	79·73	5	
		46·16	6	Co ?	80·3 †	5	80·26	5	
		46·47	6				81·03	6	
47·0 †	6	46·95	5		81·8 †	6	81·72	6	
47·3	6	47·23	5		82·4 †	2	82·35	2	
47·9 †	2·5	47·85	5		82·9 †	6	82·86	6	
		48·66	6				83·32	6	
50·5 †	5	50·44	5		84·4 †	4	84·36	3	
		51·71	5	(Co or Mn) ?	85·8 †	5·5	85·77	4	
		52·22	6		88·3 †	6	88·26	5	
		53·16	6	Mn ?	89·1 †	6	89·08	6	
		53·53 †	6	Ti ?	89·9 †	5	89·84	4	
54·6 †	3	54·50	3		90·3 †	5	90·19	4	
54·9	5·5			Ca	91·0 †	6	90·88	5	
		55·20	6				91·53	6	Mn ?
56·1	6	55·85	6	Mn			92·84 †	6	Cr ?
56·5 †	5·5	56·46	5				93·42	6	
		57·18	6	Mn ?			93·95	6	
		57·68	6	(Ti or Mn) ?	94·7 †	2	94·67	2	
58·5	6	58·35	5	Mn			95·51	6	
59·3 †	2·5	59·24	2				96·20	5	Ti ?
		59·88	6	Ru ?			97·86	6	
		60·48	6	V ?			99·03 †	6	Mn
61·4	6	61·40	6	Mn ?					
61·8 †	3	61·75	3		45		45		
62·2	6	62·11	4	Mn					
		63·33	6				02·31	6	Mn
		63·66	6	Ti ?	02·8 †	6	02·76	6	
64·9	6	64·88	4	Mn	05·0 †	6	04·93	6	
		65·39	6		08·5 †	6	08·40	6	
		65·96	6	Ti ?			09·41	6	Cu ?
66·7 †	2·5	66·70	2		09·9 †	5	09·95	6	
		67·55	6		14·4 †	5	14·29	5	
		67·96	6		15·5 †	6	15·36	6	
		68·44	6	Ti	17·7 †	4·5	17·64	4	
69·6 †	3	69·53	2		18·5 †	6	18·62	6	
		70·23	6	Mn	20·4 †	6	20·35	6	
		71·31	6	Ti ?	22·8 †	5	22·72	6	Ti ?
		71·94	6	Co ?	23·6 †	6	23·47	6	
72·9	5·5	72·84	5	Mn			24·91	5	V ?

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
45		**45**			**45**		**45**		
25·4 †	3	25·27	3		69·0 †	5	68·93	4	
		25·99	6				71·62 †	6	
26·6 †	5	26·66	4				73·05 †	6	Ta ?
		27·36	6	Ti	74·4	6	74·34	6	Ba ?
		27·99	6	Co ?	74·9 †	5	74·84	4	
28·8 †	2	28·78	1				75·87	6	
29·7 †	5	29·75	4				79·30	6	V ?
		30·51	6				79·93	6	
31·4 †	3	31·25	2		80·2 †	5·5	80·04	6	
31·8 †	6	31·75	4		80·8 †	6	80·67	5	V ?
		32·47	6		81·7 †	5	81·66	4	Ca ?
33·4 †	6	33·35	5				82·51	6	
		34·13	6	Co ?			83·04	6	
		34·94	6	Ti ?	84·0 †	5	83·93	5	
		35·65	6	Ti	85·0 †	5	84·89	5	
		36·10	6	Ta ?			86·46	6	Mn ?
		36·58	6		87·3 †	4	87·23	4	Cu ?
		37·74	6	V ?			91·52	6	V ?
39·0 †	6	38·96	5		92·7 †	2	92·75	2	
40·0	6	39·87	6	Cu ?			93·64	6	V ?
		40·77	6	Cr ?			94·25	6	
		41·43	6		95·5 †	4	95·48	4	
		42·07	6		96·3 †	5	96·13	5	
42·6 †	5·5	42·53	5				96·64	6	
		42·84	6				97·50	6	
		46·13	6		98·3 †	4	98·26	3	
		46·61	6						
47·2 †	6	47·14	4						
48·1 †	3	47·95	2		**46**		**46**		
		48·88	6	Mn	00·1	6	00·09	6	Ba
49·6 †	5	49·57	4	Ti ?	01·2 †	6	01·08	6	
51·0 †	5·5	51·10	6		02·2 †	5	02·11	4	
		51·76	6	U ?	03·1 †	2·5	03·03	2	
52·7 †	5	52·66	4	Ti ?			04·01	6	
54·2	5	54·16	6	Ba ?	04·8 †	5·5	04·84	6	
		54·63	6				05·52	6	
56·3 †	4	56·22	2				06·34	6	
		57·04	6		07·5	5·5			Sr
		57·46	6		07·8 †	4·5	07·79	3	
58·3 †	6	58·18	6		11·4 †	3	11·38	2	
60·3 †	5·5	60·26	5		13·6 †	4·5	13·35	4	
		61·09	6	V ?	14·4 †	6	14·29	6	
61·6 †	6	61·84	6		15·8 †	6	15·73	6	
64·9 †	5·5	64·87	5		19·0 †	5·5	18·88	5	
65·5 †	5·5	65·44	6		19·5 †	3·5	19·40	3	
65·8	5·5	65·81	5	Co ?	25·3 †	3	25·19	3	
66·7 †	6	66·62	5				26·65	6	Mn
67·1 †	6	67·10	6		27·6 †	6	27·65	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
46		**46**			**46**		**46**		
29·6	5·5	29·44	6	Co ?			94·97 †	6	U ?
30·3 †	3·5	30·22	4		98·6 †	6	98·50	6	Ti ?
		30·91	6						
		31·61	6		**47**		**47**		
33·1 †	3·5	33·02	4						
34·0 †	6	33·87	6		00·3 †	5·5	00·49	6	
34·9 †	6	34·92	6		01·2	5·5	01·10	6	Mn
36·1 †	5	35·95	5		05·1 †	5	05·10	5	
37·7 †	3	37·66	3		05·6 †	5·5	05·53	6	
38·2 †	3	38·13	3		07·5 †	1	07·45	2	
		40·45	6		09·3 †	4	09·18	4	
41·4 †	6	41·12	6				09·83	6	Mn
43·7 †	4·5	43·58	4		10·4 †	3	10·37	4	
		44·94	6		11·6 †	6	11·56	6	
		46·34	6	Cr	12·3 †	6	12·22	6	
47·6 †	2·5	47·54	2		14·6 †	5	14·31	6	Ni ?
50·2 †	6	49·95	6		21·2 †	5·5	21·11	6	
51·5 †	4	51·27	4		22·3	5·5	22·27	6	Zn ?
		52·21	6	Cr ?			26·38 †	6	
54·7 †	1	54·70	1		27·6	5·5	27·56	4	Mn
57·8 †	5·5	57·71	6		28·7 †	3·5	28·67	4	
58·5 †	6	58·42	6				29·13 †	6	
		58·77	6		29·8 †	6	29·84	6	
61·7 †	6	61·61	6				30·41	6	
62·2 †	5·5	62·09	5		31·6 †	4·5	31·60	6	
63·4 †	6	63·25	6	Co ?	33·8 †	4	33·71	4	
		64·46	6				34·25 †	6	
66·1 †	6	66·08	6		36·0 †	6	35·96	4	
67·6 †	1	67·56	3		37·0 †	1	36·91	1	
68·3 †	1	68·23	3				37·75 †	6	Cr ?
69·4 †	5	69·30	4				39·26	6	Mn
73·4 †	3·5	73·29	4		40·5 †	6	40·48	6	
		74·37	6				41·27	6	
74·8	6	74·78	6	Er ?	41·7 †	4	41·65	5	
		75·23	6	Cu ?	44·6 †	6			
79·0 †	1·5	78·97	2		46·0 †	3·5	45·92	5	
80·5 †	5·5	80·49	6				47·49	6	
81·6 †	6	81·58	6		48·3 †	5·5			
82·1	6			Ti ?			49·77	6	
82·3 †	6	82·18	6		50·2 †	5·5	50·13	6	
		82·74	6		51·3 †	6			
83·7 †	5·5	83·68	5		52·6 †	6	52·50	6	
		85·27	6				54·16	4	Mn
87·5 †	5	87·49	6						
88·4 †	6	88·39	6				56·20 †	6	Cr ?
89·6 †	6	89·62	6		57·8 †	4·5	57·70	5	Ti
90·3 †	5	90·26	5				61·66	6	Mn
91·5 †	3	91·52	3				62·48	6	Mn

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
47		**47**			**48**		**48**		
66·0 †	6	65·98	6		38·7 †	5·5	38·66	6	Mn ?
66·6 †	6	66·56	5	Mn	39·7 †	6	39·66	5	
67·0 †	6	67·13	6		40·5 †	6	40·42	6	Co ?
68·5 †	3	68·46	5				41·92 †	6	Ti
71·8 †	5·5	71·81	6		43·3 †	4·5	43·31	5	
73·0 †	4	72·95	5		44·2 †	5	44·13	6	
76·5 †	6	76·17	6		45·8 †	5	45·76	6	
79·6 †	6	79·55	6				48·57 †	6	Ti ?
		83·56	4	Mn			49·02	6	
86·2 †	6	86·04	6				52·09 †	6	
87·0 †	3	86·91	4				55·00 †	6	Sr ?
88·0 †	6	87·98	6		55·8 †	5·5	55·80	6	Ni
88·9 †	6	88·65	5		57·6 †	6	57·40	6	
89·8 †	2·5	89·74	3				59·20	6	
		90·54	6	Cr ?	59·9 †	1	59·86	2	
91·4 †	6	91·33	6				60·92 †	6	
		92·62 †	6				62·07 †	6	(Cr or Co) ?
		94·15 †	6		63·8 †	5·5	63·78	6	
98·4 †	5	98·38	6				69·71 †	6	Ru ?
		98·90 †	6	Ti ?			70·14	6	Ti ?
99·6 †	6	99·50	6		71·5 †	1	71·43	2	
					72·3 †	1	72·25	2	
48		**48**			76·1 †	5	76·00	6	
					78·3 †	2·5	78·33	3	Ca ?
00·0 †	6	99·98	6		81·7 †	5·5	81·80	6	
00·8 †	4	00·76	5		82·3 †	5	82·27	6	
		01·22	6	(In or La) ?	85·6 †	5	85·55	5	Ti ?
03·1 †	4	03·00	4		86·5 †	5·5	86·43	6	
		04·71 †	6		87·4 †	6	87·39	6	
07·8 †	6	07·86	6		88·8 †	6	88·71	6	
		08·25 †	6		89·2 †	5	89·14	5	
08·8 †	6	08·87	6	(Ti or Mn) ?			89·95	6	
		09·36 †	6		90·9 †	1	90·89	2	
		09·65 †	6		91·6 †	1	91·62	1	
10·7 †	5·5	10·06	6		93·0 †	6	93·02	6	
		11·22	6	Ti ?	96·6 †	5·5	96·56	6	
		13·33 †	6						
13·9	6				**49**		**49**		
		15·42	6	(Os or Ru) ?					
16·1 †	6				03·4 †	2·5	03·41	2	
18·0 †	6	17·90	6		05·3 †	6	05·30	6	
		23·63	4	Mn			06·68	6	
24·3 †	6	24·27	6		07·8 †	5	07·86	6	
		25·44 †	6	Ti ?	09·5 †	5·5	09·53	5	
27·6 †	6	27·57	6		10·2 †	4·5	10·15	4	
32·8 †	4·5	32·84	5				10·60 †	5	
34·7 †	6	34·64	6		11·9	6	11·93	6	
36·0 †	6	36·04	6	Ti ?	12·2 †	6			

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
49		49			49		49		
		13·76	6				76·03	6	Ni ?
17·4 †	6	17·41	6				77·79 †	6	
		18·15 †	6		78·8 †	4·5	78·71	4	Ti ?
19·2 †	1	19·11	2				79·66 †	6	
20·6 †	1	20·63	1				81·73	6	Ti
		21·11	6		82·7 †	3	82·67	3	
		23·26	6				83·00	6	
24·1 †	6	24·00	6		83·4 †	5	83·41	5	
24·9 †	4·5	24·89	5		84·1 †	4	83·97	4	
27·6 †	5·5	27·46	6		85·4 †	4	85·35	4	
28·0 †	5·5	27·93	6		85·7 †	4	85·68	4	
30·4 †	6	30·43	6				86·37 †	6	
32·2 †	6				89·2 †	5	89·10	5	Ti ?
33·5 †	5	33·44	6				90·56 †	6	
34·2	5	34·08	6	Ba	91·5 †	5	91·43	5	Ti ?
		37·44 †	6	Ni ?	94·3 †	3·5	94·25	4	
38·3 †	6	38·30	5				94·63	6	
39·0 †	4	38·93	3				95·81 †	6	
39·8 †	6	39·78	4				97·00 †	6	Ti ?
		41·32	6				99·23 †	6	
42·7 †	6	42·51	6						
		43·80	6						
		45·80 †	6		50		50		
46·6 †	4	46·54	4						
		48·38	6		02·1 †	2	02·02	2	
50·3 †	5·5	50·25	5		03·0 †	6	02·95	5	
52·8 †	6	52·64	6				04·14 †	6	
54·8 †	6	54·60	6				04·92 †	6	Mn ?
54·9	6	54·90	6		05·9 †	2	05·84	3	
		55·73	6		06·3 †	2	06·24	2	
		56·11	6		07·4 †	5·5	07·50	5	Ti ?
57·5 †	1	57·43	3				11·42	6	
57·8 †	1	57·80	2		12·3 †	2·5	12·15	3	
		59·61	6				12·50 †	6	
		61·15 †	6	Mo ?			12·86	6	
		62·03 †	6				13·48	6	Cr ?
62·8 †	6	62·63	6	Sr			14·10	6	
		64·65 †	6				14·42	6	Ti
66·3 †	3	66·23	3		15·2 †	2·5	15·09	3	
		66·96	6				15·40	6	
68·1 †	5	67·97	6	Sr ?			16·40	6	Ti
68·8 †	6	68·79	6				17·02 †	6	Cu ?
70·1 †	5	70·07	6				17·81	6	Ni ?
70·7 †	5	70·58	6		18·6 †	5·5	18·53	4	
		72·36	6				19·11	6	
73·3 †	4	73·29	4				19·89 †	6	Ti
		74·40	6	Mn ?			20·90 †	6	
		75·60 †	6	Ti ?			21·61 †	6	

TABLE I.--Comparison of Lines Photographed with those given by KAYSER and RUNGE (continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
50		**50**			**51**		**51**		
22·4 †	3	22·35	4				02·28	6	
		23·53 †	6				03·37	6	
		25·60 †	6	Ti			04·07	6	
27·4 †	3·5	27·28	4				04·25 †	6	
28·3 †	3·5	28·25	4				04·45 †	6	
29·8 †	6	29·73	6		05·7 †	3	05·66	2	Cu ?
		30·99 †	6	Mn ?			06·57	6	
		31·95 †	6		07·6 } †	3	07·53	4	
		36·40 †	6	Ti	07·8 } †	3	07·76	3	
		36·90 †	6				09·75	6	(Mo or Ti) ?
39·5 †	5·5	39·38	5		10·6 †	3·5	10·50	3	
41·1 †	3	41·17	4				11·21	6	
41·8 †	3	41·85	2				14·45 †	6	
44·4 †	6	44·38	5				15·87	6	
		47·85	6				17·98	6	Mn
48·7 †	6	48·57	5				19·77	6	
50·0 †	2·5	49·94	2				20·32	6	Ti ?
		50·58	6		21·8 †	6	21·71	5	
		50·98	6		23·9 †	4	23·82	3	
51·8 †	3·5	51·72	3				24·18	6	
		53·65 †	6	Mo ?	25·4 †	3·5	25·27	2	
		54·71 †	6	Ba ?	26·4 †	6	26·31	6	
		60·11 †	6	Mn ?			26·70	6	
65·2 †	3·5	65·09	3	Ti ?	27·5 †	5	27·44	4	Ti ?
67·3 †	5·5	67·22	6				28·15	6	
69·0 †	2·5	68·88	2				29·73 †	6	
72·3 †	6	72·04	6	Ti ?	31·6 †	5·5	31·51	4	
72·8 †	6	72·82	6	Cr ?	33·9 †	2	33·64	2	
75·0 †	3	74·80	4				36·12 †	6	
76·5 †	6	76·43	5		37·6 †	5	37·50	3	
79·2 } †	3	79·00	6				38·12	6	V ?
79·4 } †	3	79·36	3		39·4 } †	1	39·34	1	
79·9 †	5	79·85	3		39·6 } †	1	39·58	1	
		80·37	6		41·9 †	5	41·85	4	
		80·78 †	6	Ni ?	42·7 †	4	42·63	4	Ni ?
		83·14	6		43·0 †	4	42·99	4	
83·5 †	3	83·46	3				44·17 †	6	
		84·26 †	6	Ni ?	45·3 †	6	45·17	6	
		87·16 †	6	Ti ?			46·57 †	6	Ni
		88·15 †	6				48·15 †	5	
91·0 †	4	90·90	4		48·4 †	4	48·36	3	
97·2 †	4	97·07	4				49·43	6	Mn
98·7 †	3	98·77	3		51·0 †	4·5	50·96	3	Mn
		99·17	6	Ni ?	52·1 †	4·5	52·00	4	Ti
					53·4 †	3	53·28	3	Cu ?
							57·18 †	6	
51		**51**			59·3 †	6	59·09	4	Cu ?
		00·00	6	Ni ?			60·39 †	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
51		**51**			**52**		**52**		
62·5 †	2	62·49	3		17·6 †	4	17·49	4	
		64·65 †	6		18·1	3·5	18·03	5	Cu
65·6 †	5·5	65·52	4		18·4	3·5	18·28	5	Cu
66·5 †	5·5	66·36	4		19·9 †	6	19·76	6	
67·5 †	1	67·50	1				21·09 †	6	Cr ?
69·2 †	5	69·09	3	Ni ?			21·89 †	6	
		70·08	6				22·63 †	6	Sr ?
		70·86	6				23·28 †	6	
		71·15	6	Mo ?			24·40	6	Ti
71·8 †	1	71·71	2		25·7 †	6	25·60	5	
		73·85	6	Ti			26·25	6	
		77·40 †	6	Ba ?			26·63	6	Ti ?
		78·89 †	6	V ?	27·1 †	1	27·00	1	
80·3 †	6	80·14	5		27·4 †	1	27·33	1	
		81·40 †	6	V ?			27·85	6	
		81·90	6				28·53 †	6	
84·2	6	84·42	4		30·1 †	4	29·95	3	
84·8 †	6						31·49	6	
		86·65	6				32·48	6	
88·1 †	5·5	88·00	5	U ?	33·1 †	1	33·05	1	
		88·90	6				34·77 †	6	Mn ?
91·7 †	1	91·56	1		35·6 †	5·5	35·50	4	
		92·10	6				36·33 †	5	
92·5 †	1	92·47	1				42·00	6	
		93·10	6	Ti	42·7 †	4	42·58	3	
		94·20	6		44·0 †	6	43·95	5	
95·1 †	2	95·03	2		47·3 †	6	47·20	5	
95·7 †	4	95·59	4				49·17 †	6	
96·3 †	5	96·20	6		50·4 †	4	50·33	6	
		96·69	6	Mn			50·76	3	
		97·68	6		52·2 †	6	52·08	5	
		98·09	6		53·6 †	5	53·56	4	
98·9 †	4	98·82	4		55·2 †	5·5	55·08	5	
		99·70	6				55·44 †	6	
							57·77 †	6	Co ?
52		**52**			63·5 †	4	63·42	3	
							64·00	6	Cr ?
		01·22	6		66·7 †	2	66·72	1	Co ?
02·5 †	3	02·42	2				68·73	6	Co ?
04·7 †	5·5	04·65	4	Cr	69·7 †	1	69·65	1	
		05·17	6		70·5 †	1	70·43	1	Ca ?
		06·13 †	5	Cr			71·37	6	
		07·95	6				72·28	6	(Ti or Cr) ?
		08·11	6		73·4 } †	4·5	73·32	4	
08·8 †	3	08·72	3	Cr ?	73·6 }	4·5	73·55	3	
		12·85	6	Co	75·2 †	6	75·12	6	
15·4 †	4	15·28	4				76·19 †	6	Cr ?
16·5 †	4	16·37	3				77·80	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
52		**52**			**53**		**53**		
		78·95	6				44·64	6	Co ?
		80·53 †	5	Co ?			45·75	6	Cr ?
82·0 †	4	81·91	2				46·62	6	
83·8 †	3	83·75	1				47·62	6	Co ?
		84·63 †	6				48·58	6	Cr ?
		85·76 †	6		49·9 †	5·5	49·83	4	
		87·48	6	Cr ?	53·6 †	4·5	53·53	3	Co ?
88·7 †	6	88·64	4	(Ti or Mn) ?			56·28 †	6	
		89·22	6				58·16 †	6	
		91·07	6				59·97	6	
		92·78	5	Cu ?			61·80 †	6	Ru ?
		94·05 †	5	Pd ?	63·0 †	6	62·90	5	Co ?
		94·63 †	6		65·1 †	3	65·02	3	
		95·41 †	6	Ti ?	65·6 †	6	65·62	4	
		96·82	6	Cr	67·6 †	2	67·60	2	
		98·91 †	5		70·2 †	2	70·09	2	
					71·7 †	2	71·62	1	
							72·01	6	
53		**53**			73·9 †	5·5	73·85	4	
		00·25 †	6				75·57	6	
02·5 †	3	02·46	1				77·08 †	5	(Cu or W) ?
		04·22	6	Cr ?			77·88 †	5	Co
		06·31	6				79·01	6	
07·6 †	5	07·48	3		79·8 †	5·5	79·70	4	
		09·89	6		83·6 †	2	83·50	1	
		11·61	6				85·63	6	
		13·44	6				86·63 †	6	
15·3 †	6	15·19	6				87·80 †	6	Cr ?
16·8 †	5	16·85	5	Co ?	89·7 †	5	89·71	4	
		19·24 †	6		91·7 †	5	91·75	4	Cu ?
		20·28 †	6		93·4 †	3	93·30	2	
		21·36 †	6				94·74	6	Mn ?
22·3 †	6	22·30	5				95·42	6	
		23·70	6		97·3 †	2	97·27	1	
24·4 †	1	24·31	1		98·5 †	6	98·34	5	
		26·32 †	6	Co ?			99·65	6	Mn ?
28·3 †	1	28·15	1						
28·7 †	1	28·50	2						
		28·94	6		**54**		**54**		
30·2 †	6	30·15	4	Sr ?	00·7 †	5	00·60	3	Cr ?
33·1 †	5	33·04	3				01·97	6	Co ?
		35·25	6	Co ?			02·91	6	
		35·47	6		04·4 †	2	04·35	2	
		37·37	6		06·0 †	1·5	05·91	1	
40·2 †	3	40·10	2				07·73 †	6	Mn ?
41·3 †	3	41·15	2	Mn ?			09·30 †	6	
		41·49	6				09·75	6	Cr
43·6 †	6	43·62	4		11·1 †	2	11·13	2	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
54		**54**			**54**		**54**		
		13·30	6		76·8 †	3	76·82	2	
15·4 †	1·5	15·43	1		78·6 †	6	78·60	5	
		17·15 †	6		81·1 †	4·5	81·06	4	
		18·66	6	Ti ?	81·6 †	4·5	81·62	4	(Mn or Ti) ?
		20·52 †	6	Mn	83·3 †	6	83·28	4	Co ?
		22·16	6		83·5 †	6			
24·3 †	2	24·20	1				86·00 †	6	
		26·14	6		87·9 †	4	88·00	4	
		27·13	6		90·1 †	6	90·10	6	
		28·03	6				91·98 †	5	
		29·10	6		93·7 †	6	93·70	4	
29·9 †	2	29·74	1		94·7 †	6	94·62	5	
		31·82	6				95·75	6	
		33·15	5	Mn ?			96·92	6	
34·7 †	2	34·66	2				97·52	3	
		36·74 †	5		97·7 †	3·5	97·73	6	
		37·50 †	6	Co ?			97·96	6	
		38·51 †	6				99·60	6	
		39·48	5		**55**		**55**		
		40·41	6						
		41·56 †	6	V ?			00·87	6	
		42·42	6		01·7 †	3	01·61	2	
		43·33	6		03·3 †	6	03·32	5	
45·3 †	4·5	45·21	2				04·51 †	6	Sr ?
47·1 †	2	47·05	1				06·06	6	
		48·52 †	6		07·0 †	2·5	06·92	2	
		49·16	6				08·53 †	6	
		49·95	6	Zr ?			10·70 †	6	
		51·00	6	Sr ?	12·5 †	6	12·47	5	
		52·10	6				14·71	6	Ti ?
		52·96 †	6				16·80 †	6	Mn ?
		54·53	6	Co ?			17·25	6	
55·6 †	1	55·80	1				19·65	5	Ba ?
		57·72	5				21·26 †	6	
		59·69	6		22·6 †	6	22·60	5	
		61·68	6				24·40 †	6	Co ?
63·2 †	4	63·19	6		25·7 †	5	25·70	4	
63·5 †	5	63·41	2		29·4 †	6	29·26	5	
		64·46 †	5				30·71 †	6	
		65·20	6				31·16	6	Co ?
66·6 †	4·5	66·52	4		32·2 †	6	32·13	6	
		67·15 †	5		33·0 †	6	32·87	6	Mo ?
		69·11	6				33·10	5	
		70·36 †	6				34·87	6	Sr ?
		70·79 †	5	Mn ?	35·6	5	35·52	4	Ba
		72·88 †	5				36·63	6	
74·1 †	4·5	74·08 †	3				37·86 †	6	Mn ?
		76·43 †	4		38·7 †	6	38·68	5	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
55		**55**			**56**		**56**		
		39·40	6				14·09	6	
		39·91	6		15·8 †	1	15·81	1	
		40·93 †	6				17·39 †	6	
		41·14	6				17·90	6	
		42·09	6		18·8 †	6	18·81	5	
43·4 †	5	43·24	4	Sr?			19·70 †	6	Di?
44·2 †	4	44·07	4		20·7 †	6	20·70	5	
46·7 †	5·5	46·60	5				21·72	6	
		47·12 †	5				23·61	6	
		50·00 †	5				23·95	6	
53·8 †	6	53·70	6		24·7 †	3	24·70	2	
55·1 †	4	54·96	3				25·95 †	6	
58·2 †	6	58·00	5				26·87	6	
60·4 †	6	60·36	5				27·72	5	(Ni or Mn)?
62·9 †	6	62·78	5				28·68	6	Cr?
63·8 †	4·5	63·73	4				29·33	6	
65·9 †	4·5	65·76	3				30·70	6	Sn?
67·6 †	6	67·50	4	Mn?			31·84	5	Mo?
		68·89	6				32·54 †	6	
69·8 †	2	69·77	1		34·2 †	5	34·16	4	
		71·51	6				36·08	6	
73·0 †	2·5	73·05	1				36·84 †	6	Co?
		74·99	5		37·4 } †	6	37·29	6	
76·3 †	3	76·22	2		37·6 }	6	37·53	6	
78·9 †	6	79·21	6		38·5 †	4	38·45	3	
		80·99	6				40·60 †	6	
		83·13	6		41·7 †	5·5	41·60	4	
		85·00	5				42·76	6	Cr?
87·0 †	1	86·92	1				42·99 †	6	
89·0	6	88·92	6	Ca	44·3 †	6	44·15	5	
90·3 †	6	90·30	6	Ca			45·95	6	
		91·16	6				46·20	6	
		92·64	6				46·84	6	
94·7 †	5	94·73	5	Ca?	48·8 †	6			
		96·48	6		49·3 †	6			
98·5 †	5	98·37	4	Ca?	49·9 } †	6	49·90	6	Mo?
					50·2 }	6	50·24	6	Mo?
56		**56**					50·96 †	6	
							51·53	6	
		00·39	5				52·51	5	
		01·77	6	Ca	54·1	6	54·21	6	
03·2 †	2	03·14	2	Ca?	55·4 } †	4	55·40	5	
		05·12	6		55·7 }	4	55·64	4	
		06·30	6				56·84	6	
		07·90	5				57·90	6	Di?
		09·12 †	6		58·7 } †	2			
		10·05 †	5		59·0 }	2	58·93	1	
		12·11 †	6		60·7 †	6	60·95	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
56		**56**			**57**		**57**		
		61·50 †	6				27·20 †	6	U ?
62·7 †	3	62·68	2	Ti ?			27·86	6	
		63·94 †	6	(Ni or Cr) ?	32·0 †	4	31·91	3	
		64·85	6				33·97	6	
66·9 †	6	66·95	6				37·11	6	
		67·67	4				38·43 †	6	
		68·65	6				40·10 †	6	
71·6 } †	6				42·0 †	5	42·02	5	
72·0 }	6	72·32	6				43·04 †	6	
79·3 †	4·5	79·18	4				45·34	6	
		80·42 †	6	Ti ?	47·9 †	5	48·01	5	
		83·25 †	6		52·3 †	6	52·11	5	
		84·84	6		53·4 †	4	53·28	2	
86·7 †	4	86·60	3				54·44	6	
		88·52	6	Na	54·9 †	5	55·24	6	Ni ?
		90·76	6		57·0 †	5·5	56·85	6	
91·6 †	6	91·64	5				59·37 †	6	
93·8 †	5	93·77	5				59·73	6	
		95·21	6	Ni ?			60·51	5	
		96·02 †	6		61·1 †	5·5	61·39	6	
		98·23 †	6				61·70	6	
		98·55	5	Cr ?			62·58	6	
		99·62	6		63·2 †	3	63·15	1	
							65·34	6	
57		**57**					69·37	6	Hg ?
							71·28 †	6	
		00·37	4	Cu ?			74·49	6	Ti ?
01·7 †	4·5	01·71	3		75·3 †	4	75·24	3	
		02·50	6	(Cr or Ti) ?			78·58 †	6	Ba ?
		03·66	6				80·84 †	5	(Mn or Cr) ?
		04·87	6		82·4 †	5	82·28	2	Cu ?
		05·65	5				84·00	6	K ?
06·2 †	4·5	06·14	4				84·78 †	6	
		07·15 †	5				85·50 †	6	(Cr or Ti) ?
08·6 †	4·5	08·25	5				88·45	6	Cr ?
09·6 } †	1	09·56	2				90·55	6	
09·8 }	1				91·2 †	5	91·14	4	
12·1 †	4·5	12·02	5				91·82 †	6	
12·4 †	4	12·30	5				94·09 †	5	
		13·54	6		98·4 †	6	98·38	5	
		14·34 †	5						
15·3 †	5	15·24	4	Ti ?	**58**		**58**		
		16·20 †	6						
18·0 †	4	18·03	3				00·21	6	
		20·95 †	6				04·22 †	6	(Ni or Ti) ?
		22·00	6				04·63 †	6	
		23·82	6	Yt ?			05·83	6	
		24·52 †	6				06·83 †	5	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
58		58			59		59		
		08·10 †	6				00·41	6	
09·4 †	5	09·39	5				01·87	6	
		11·99 †	6				02·64	5	
		15·02 †	5				05·13	6	
		15·54	6		05·9 †	5	05·82	3	
16·6 †	5	16·50	3				08·14	6	
		27·83	6				10·16	4	
		30·80	6				12·37	5	
		34·22 †	6		14·4 †	2	14·32	1	
		35·52	5				15·65	6	
		36·00 †	6				16·41	3	
		37·88 †	5				17·32	6	
		38·60	5				18·18	6	
		45·13	6				19·11	6	
		45·93	6				20·62	6	
		48·25 †	5	(U or Mo) ?			21·69	6	
		49·07	6				22·67	6	
		49·80 †	6				23·66	6	
		52·35 †	5	(U or Mo) ?			24·83	6	
		53·38 †	6				26·95	6	
		54·01	6	Ba ?			28·00 †	4	
		55·30 †	6		29·9 } †	2			
		56·24 †	5		30·4 } †	2	30·25	1	
		57·71	6	Ca			34·21	6	
59·8 †	5	59·83	2		34·9 †	2	34·81	2	
62·6 †	5	62·51	1				38·85	6	
		64·38	6				39·34	6	
		71·28	6				41·24	4	
		71·72	6				42·61 †	5	
		73·44	5				47·77	6	
		74·82 †	6				49·55 †	4	
		75·76	6		52·9 †	4	52·94	2	
		76·71	6				54·65	6	
		78·01 †	6				55·86 †	6	
		79·80 †	4				56·85	3	
		80·27	6				58·38 †	4	
		81·60 †	6				60·04	6	
		82·52	6				62·28 †	5	
84·1 †	3	84·05	4				63·82	6	
		88·10	6				64·87	6	
		89·22	6				66·88	6	
		91·04 †	6				68·10 †	6	
		92·04 †	6				69·28	6	
		92·88 †	5	U ?			69·92	6	
		94·49	6				72·22	6	
		95·16	6				73·36	6	
		98·33 †	5				74·65	6	
		99·40 †	6		75·6 †	3	75·51	3	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER.)	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
59		59			60		60		
77·0 †	3	76·93	2				63·54	6	
		78·97	6				64·92	6	
83·9 †	3	83·91	3		65·7 †	1	65·64	1	
85·0 †	3	84·98	2				67·88	5	
87·3 †	4	87·21	3				70·10	5	
		88·67	6				72·12	5	
		90·04	6				74·21	5	
		91·42	6				76·66	6	
		93·37	6		78·7 †	3	78·64	3	
		95·12	6				79·29	5	
		97·04	6				81·77 †	6	
		98·05 †	4				82·84 †	6	
		99·45 †	6				85·42 †	6	
							87·00	6	
60		60					88·49	6	
							89·68 †	4	
		01·36	6				90·38	5	
03·2 †	3	03·17	3				92·02	6	
		05·70 †	5				93·84 †	4	
		06·70	6				94·50 †	6	
08·2 } †	3	08·14	4				95·88	6	
08·8 }	3	08·80	2				96·89 †	5	
		12·50 †	6				98·61 †	4	
		13·68	4						
		15·85	6		61		61		
		16·87	4						
		18·20	6				00·42	6	
20·3 †	2	20·28	3		02·4 †	3	02·30	2	
		22·02	4		03·4	3	03·35	2	
24·3 †	1	24·21	1				05·51	6	
		26·47	6				07·22 †	6	
27·3 †	3	27·22	3				09·44	5	
		28·56	6				10·81	6	
		30·49 †	6				11·82	6	
		31·43	6				13·01 †	5	
		32·70	5				15·50	6	
		34·27 †	5				16·34 †	4	
		35·63 †	5				17·49	6	
		40·00	6				18·67	6	
42·3 †	3	42·24	3				19·67	6	
		43·86	6				22·42	5	
		44·57	6				23·81 †	5	
		54·20 †	5				25·16	6	
56·2 †	3	56·15	3				26·16	6	
		57·34	6				27·32	6	
		59·43	6		28·1 †	4	28·04	3	
		61·41	6				29·22	6	
		62·98	5				30·48	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
61		61			61		61		
		31·59 †	5				96·24	6	
		32·63	6				99·61	6	
		33·67	6						
		34·73	6		62		62		
		35·89	6						
36·8 †	1	36·76	1				00·46 †	3	
		37·06	6				02·59	6	
37·9 †	1	37·84	1				04·98	6	
		39·00	6				06·98	6	
		40·12	6				09·11	6	
		41·13	6				11·25	6	
41·9 †	6	41·88	3		13·6 †	4	13·57	2	
		43·17	6		15·3 †	4	15·29	3	
		44·26	6				16·49	6	
		45·38	6				17·81	6	
		46·46	6				18·51	6	
		47·43	6		19·5 †	4	19·42	2	
48·0	6	47·96	4				20·93 †	6	
		49·24 †	6				21·57	6	
		50·47	6				22·31	6	
		51·78 †	4				24·42	6	
		53·75	6				26·95 †	5	
		54·86	6				27·78	6	
		57·29	6				28·72	6	
57·9 †	6	57·87	3				29·34	6	
		59·47	6				30·16	6	
		60·95	6		30·9 †	1	30·88	1	
		62·40	5				31·76	6	
		63·23 †	6		32·8 †	3	32·83	3	
		63·70	5				35·26	6	
		65·51 †	4				37·44	6	
		66·80	6				38·53	6	
		68·18	6				39·54	6	
		69·77	6				40·47 †	6	
70·7 †	3	70·62	3				40·77	4	
		72·60	6				41·73	6	
73·5 †	6	73·48	4				43·06	6	
		78·80	6				44·20	6	
		80·34 †	3				45·69	6	
		83·15	5		46·5 †	2	46·48	2	
		85·90	5				47·68	6	
		87·42	6				48·85	6	
		88·25 †	4				50·56	6	
		89·54	6				51·90	6	
		90·35	6		52·7 †	1	52·71	1	
		90 84	6		54·4 †	3	54·40	3	
91·7 †	1	91·70	1				56·52 †	3	
		93·89	6				58·87	5	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

Wave-length (LOCKYER).	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.	Wave-length (LOCKYER.)	Intensity. 1 = strongest.	Wave-length (KAYSER & RUNGE).	Intensity. 1 = strongest.	Possible origin.
62		**62**			**63**		**63**		
		61·26	5				45·86	6	
		63·31	6				55·16 †	4	
		64·28	6				56·39	6	
65·3 †	5	65·27	2				57·61	6	
		67·97	6				58·83 †	4	
		69·26	6				60·20	6	
		70·39 †	3				61·01	6	
		71·49 †	5				61·90 †	6	
		74·10	6				63·01	5	
		77·61 †	6				64·69 †	5	
		80·06	6				67·53	6	
		80·74 †	4				69·79	6	
		83·17 †	5				71·60	6	
		85·23 †	5				73·89	6	
		88·67 †	6				76·09 †	6	
		91·10 †	3				78·16	6	
		92·88 †	6				79·32	6	
		93·94 †	5				80·89 †	3	
		96·67	6				82·37	6	
		97·90 †	3				83·57	6	
		99·31	6				85·00	5	
							86·28	6	
63		**63**					87·44	6	
							89·51	6	
		00·60	6				91·50	6	
01·6 †	2	01·61	1				92·96	6	
02·6 †	2	02·65	3		93·8 †	2	93·63	2	
		09·53	6				93·83	6	
		10·59 †	6				96·22	6	
		11·62 †	5				98·30	6	
		15·42	4				99·68	6	
		15·92	5						
		17·27	6		**64**		**64**		
18·2 †	3	18·16	1						
		20·42	6		00·2 †	1	00·13	1	
		21·78	6				02·74	6	
		22·83 †	3				04·98	6	
		24·60	6				08·25 †	3	
		26·84	5				11·18	6	
		28·93	5		11·9 †	2	11·83	2	
		31·04 †	5				14·23	6	
		33·49	6				17·24	6	
		34·62	6		20·2 †	2	20·23	3	
35·5 †	3	35·43	2		21·6 †	2	21·52	2	
37·0 †	3	36·97	1				26·75	6	
39·3 †	6	39·17	5		31·1 †	2	30·99	2	
		41·73 †	6				32·85	6	
		44·28 †	4				33·42	6	

TABLE I.—Comparison of Lines Photographed with those given by KAYSER and RUNGE—(continued).

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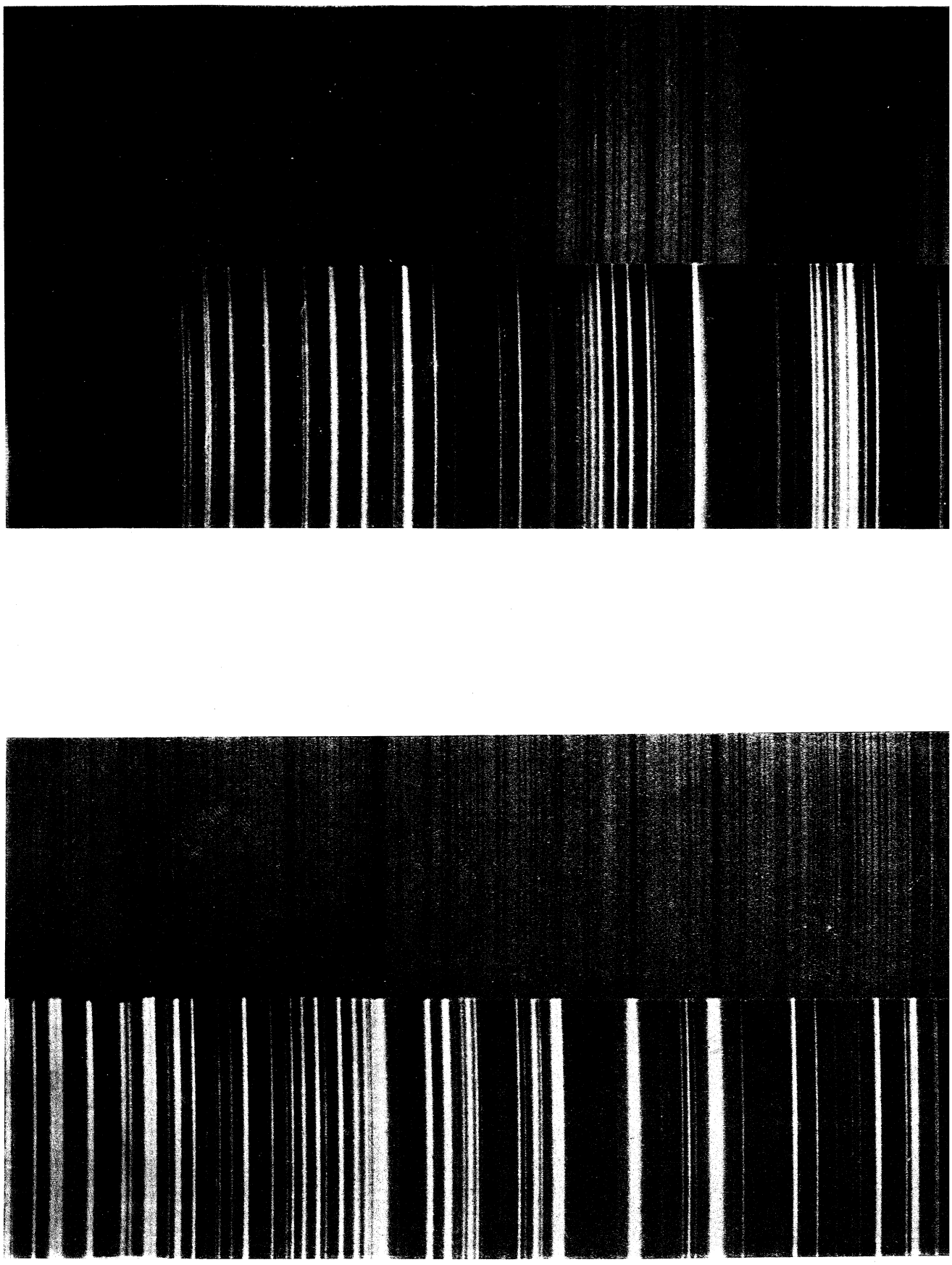
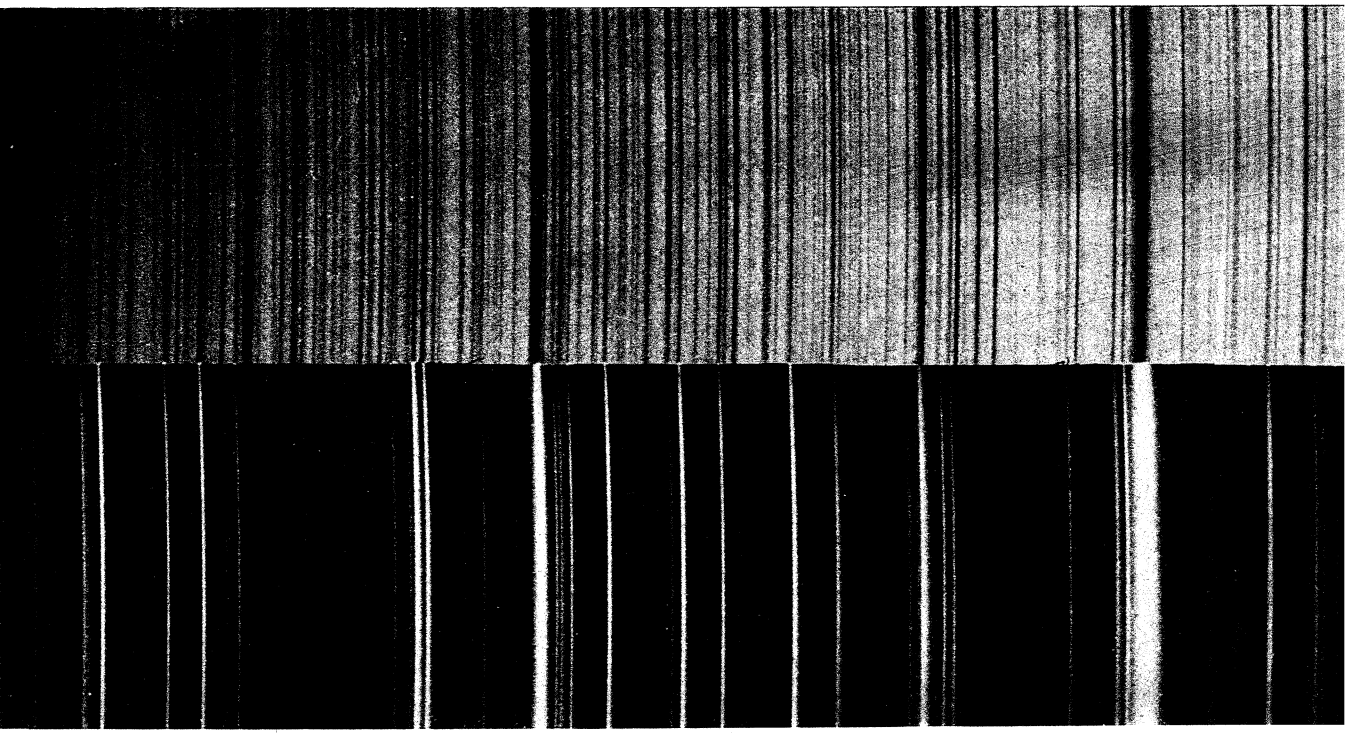
64		**64**					**65**		
		36·79	6				69·36	2	
		39·24	6				71·33	6	
		50·08	6				72·87	6	
		56·51 †	6				75·19	3	
		57·19	6				77·83	6	
		62·76 †	4				81·45	5	
		69·40 †	4				84·80	5	
		71·58	6				86·14	6	
		75·73 †	4				91·79	6	
		81·97 †	4				93·07	1	
		83·93	6				94·00	3	
		86·08	5				97·93	4	
		88·39	5						
		90·60	6				**66**		
		92·81	6				05·34	6	
		94·09	6				08·06	6	
95·2 †	1	95·13	1				09·25	3	
97·2 †	5	96·68	5				11·94	6	
		99·13 †	5				14·05	6	
							27·77	4	
		65					33·90	3	
		01·77 †	5				40·13	4	
		04·38	5				44·85	6	
		07·43	6				47·69	6	
		10·15	6				54·30	6	
		15·95	6				63·60	3	
		18·51	3				65·58	6	
		23·59	6				68·18	6	
		28·81	6				78·14	2	
		34·07	5						
		38·77	6				**67**		
		44·14	6				08·04	5	
		46·40	1				50·36	5	
		56·92	6						

Lockyer.





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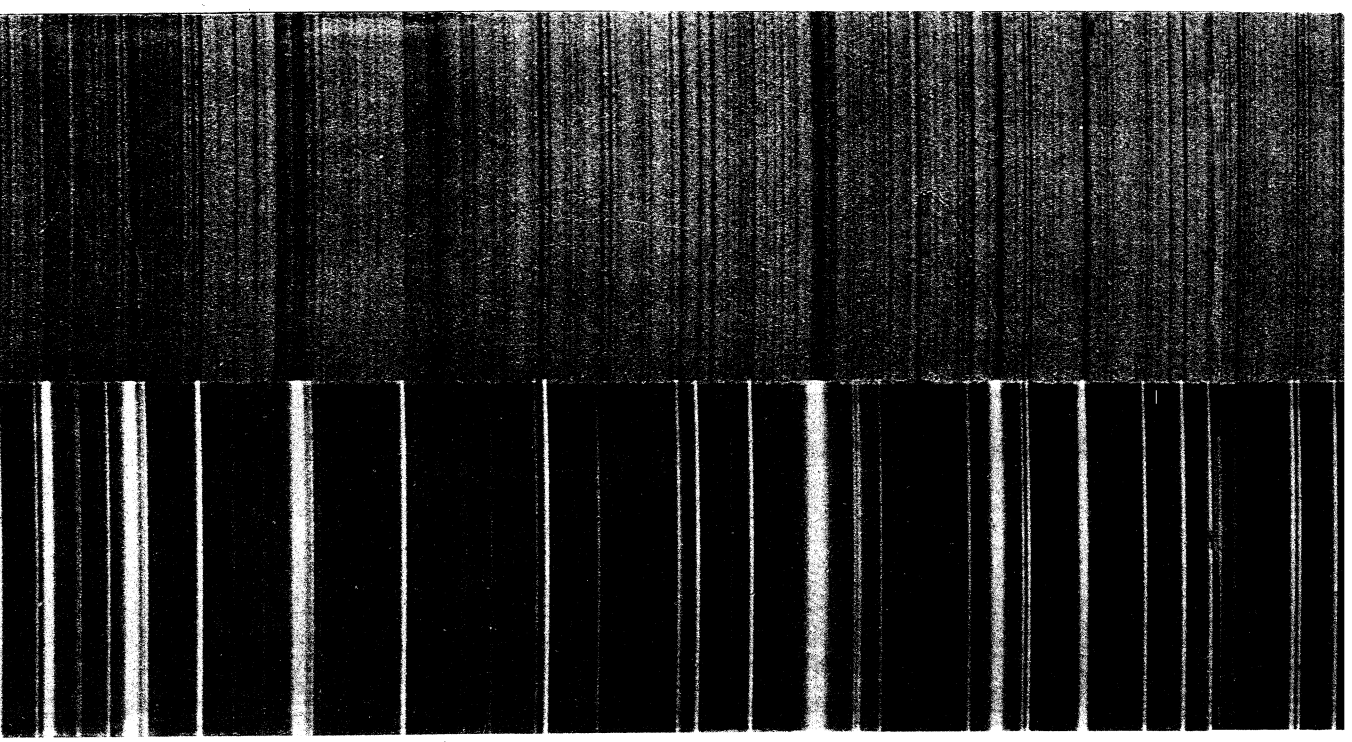

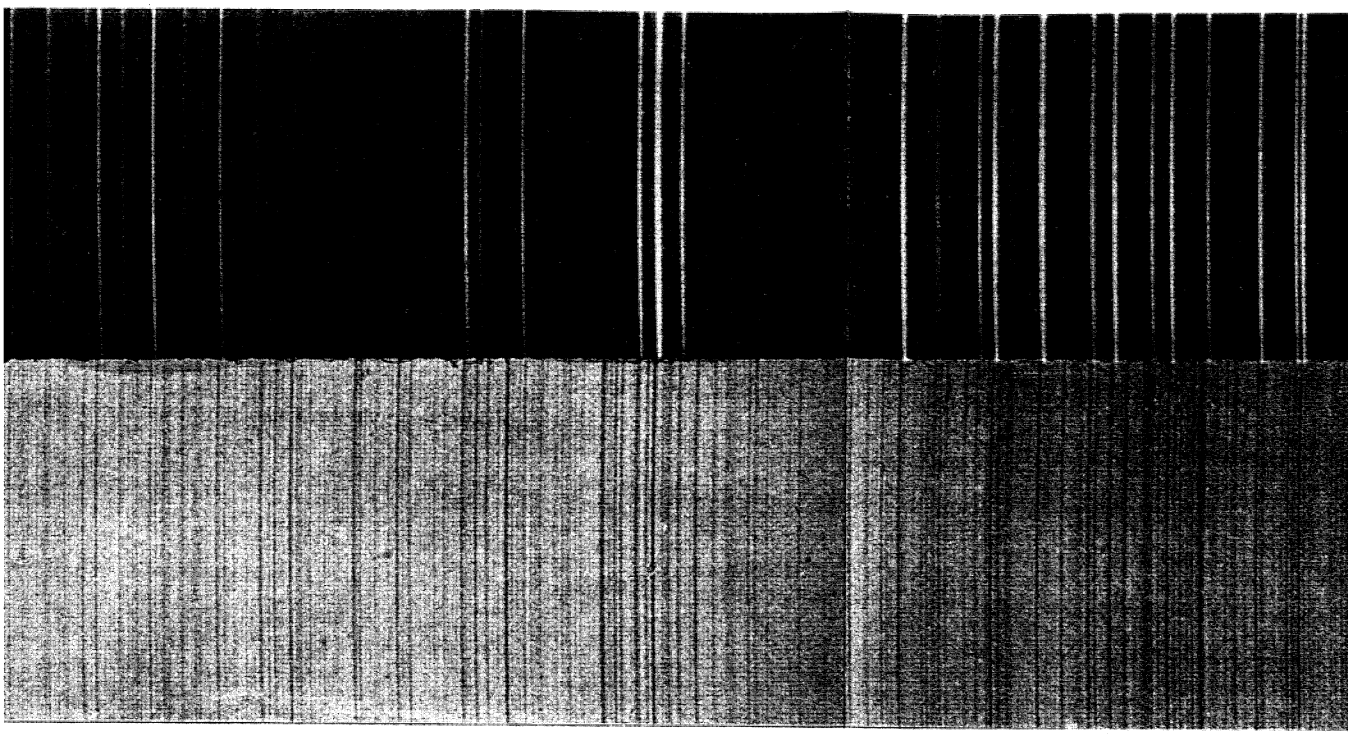

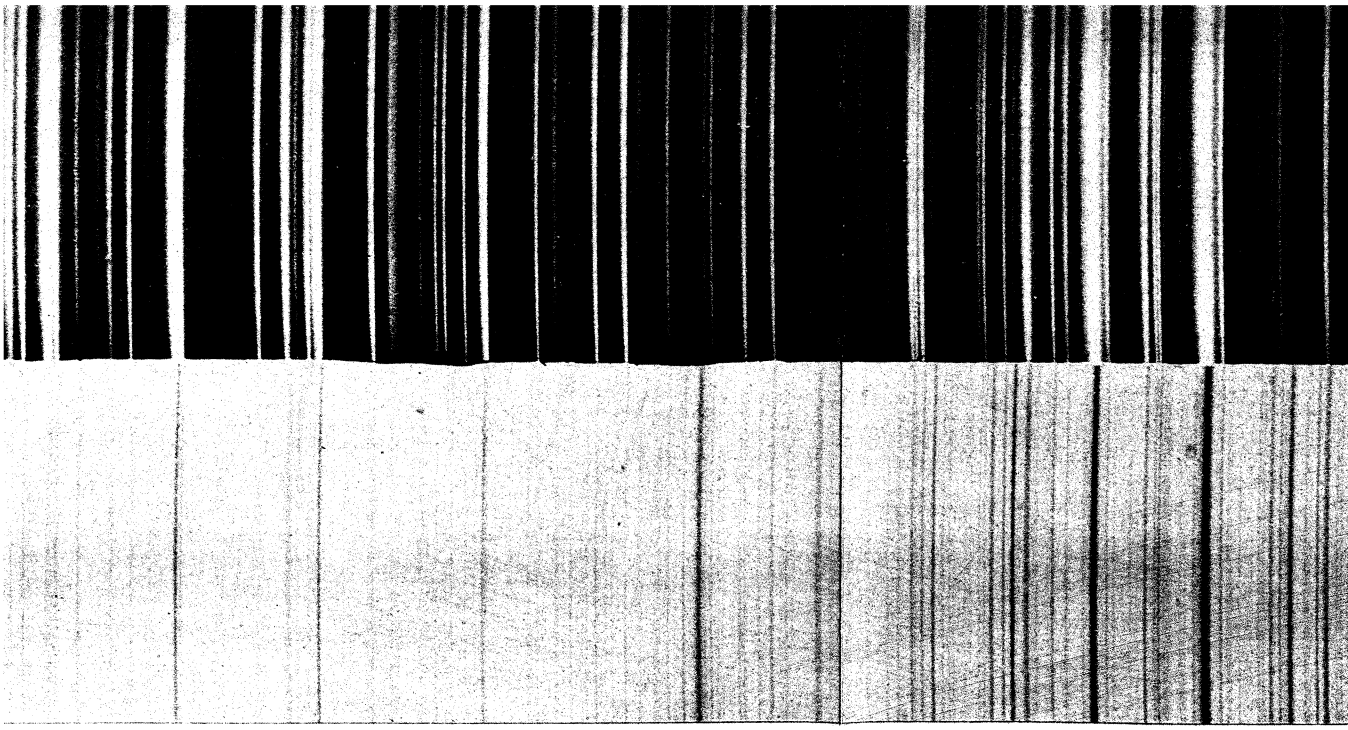

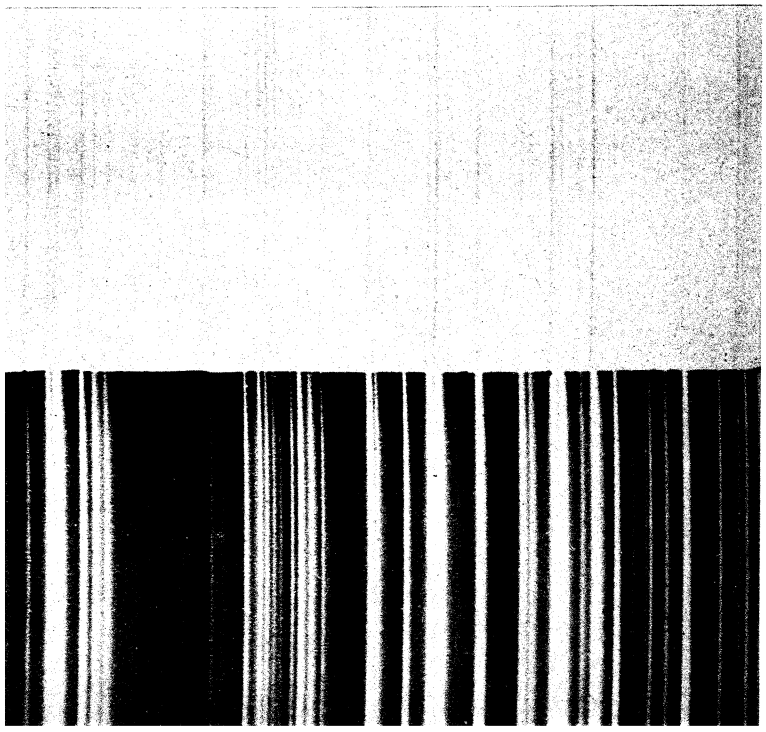

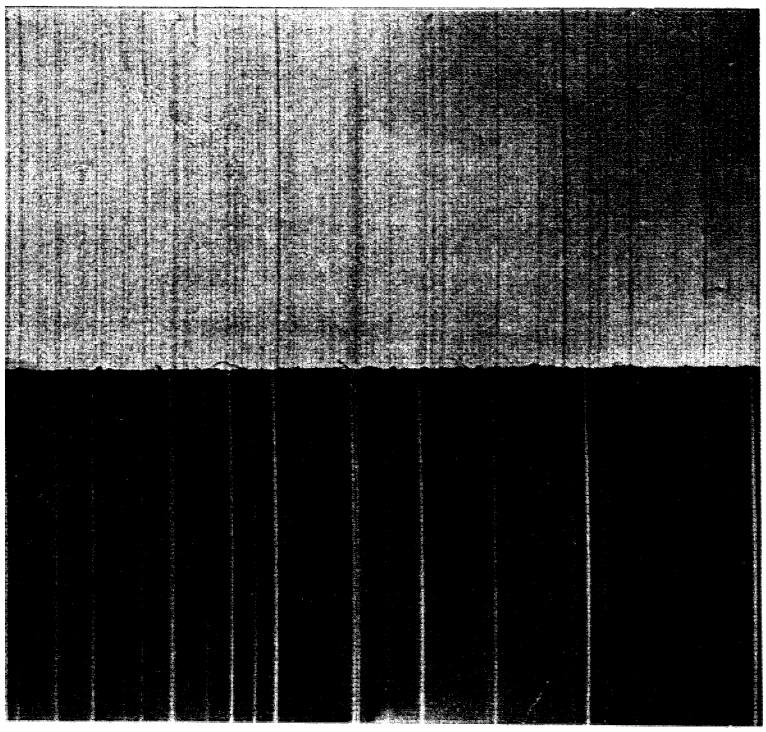

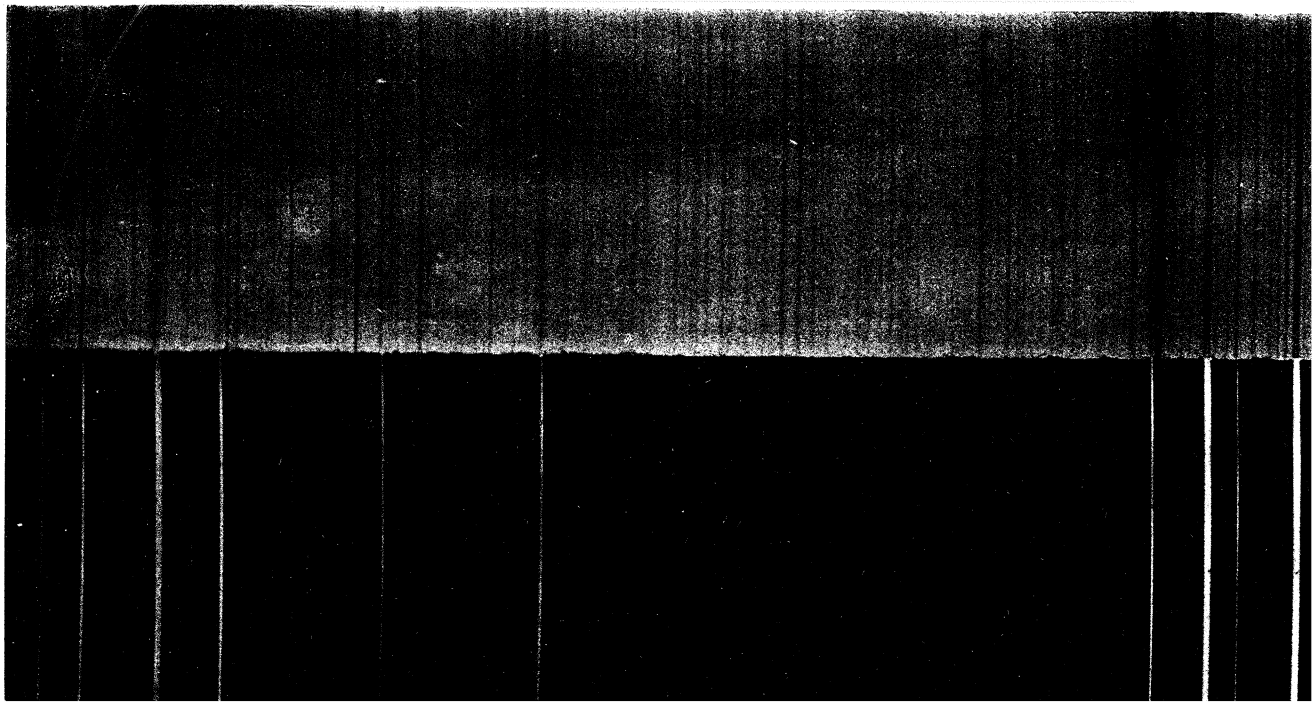

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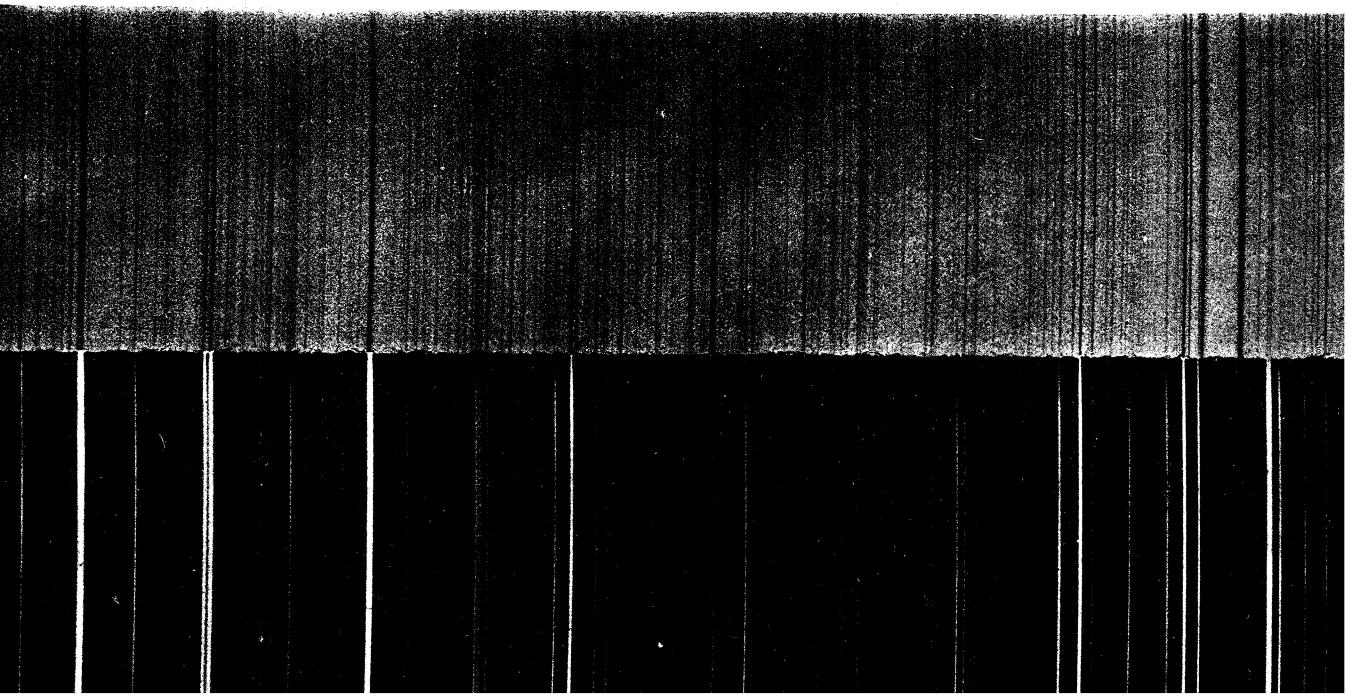

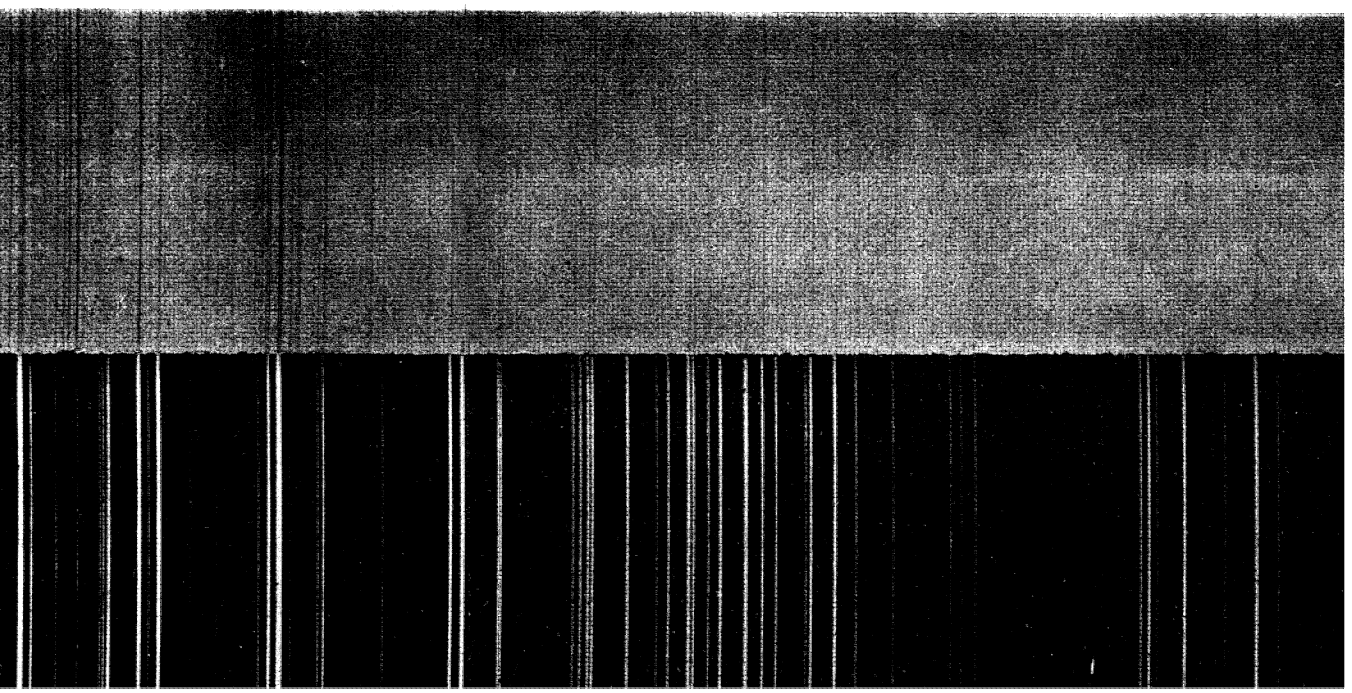

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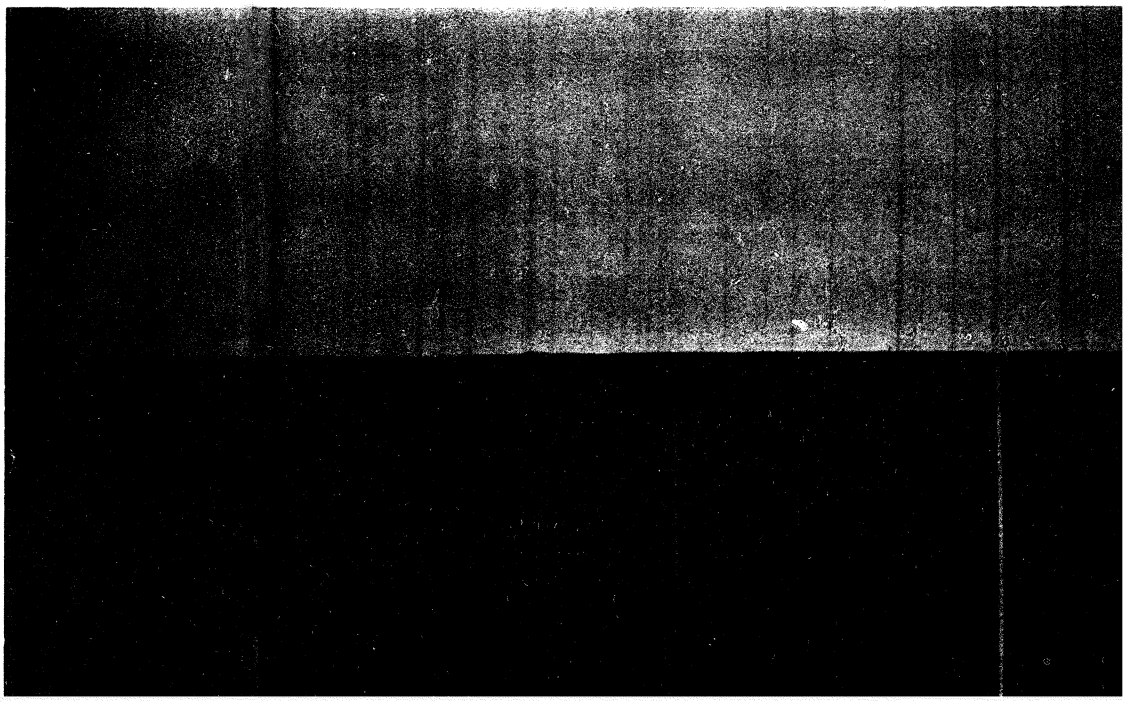

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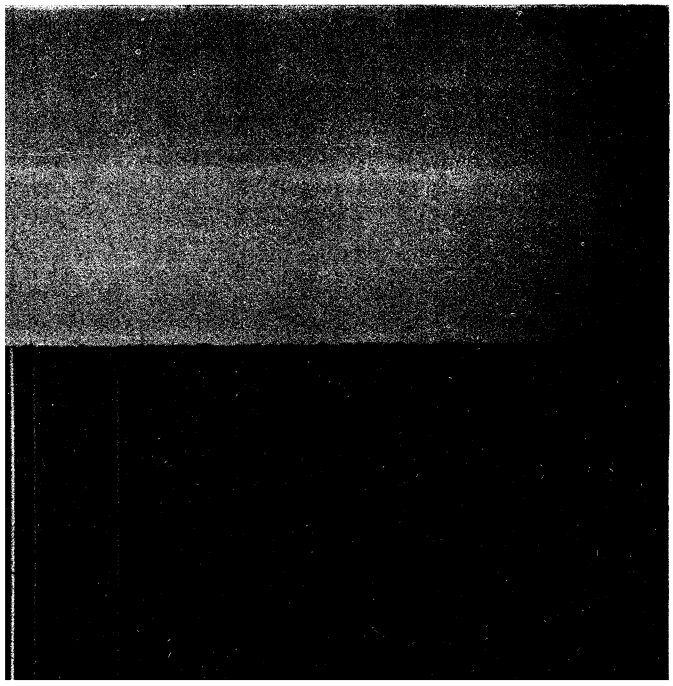

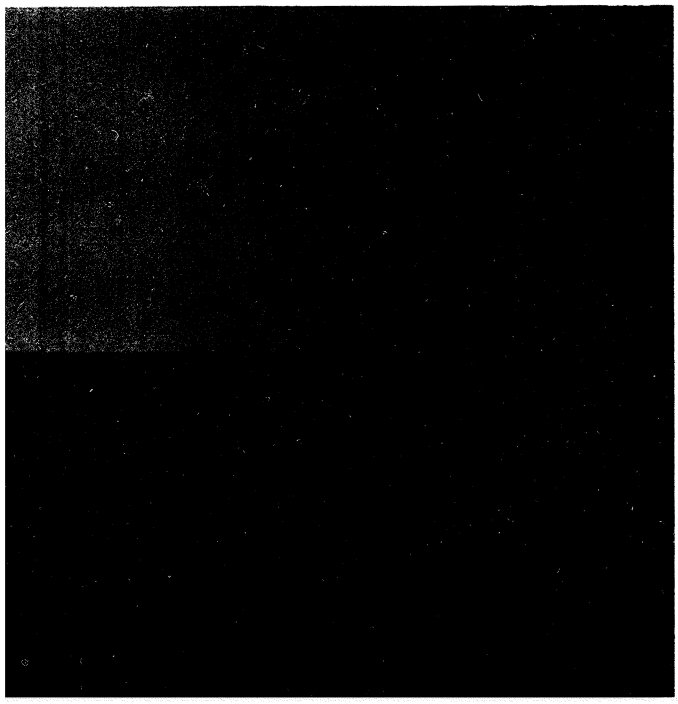

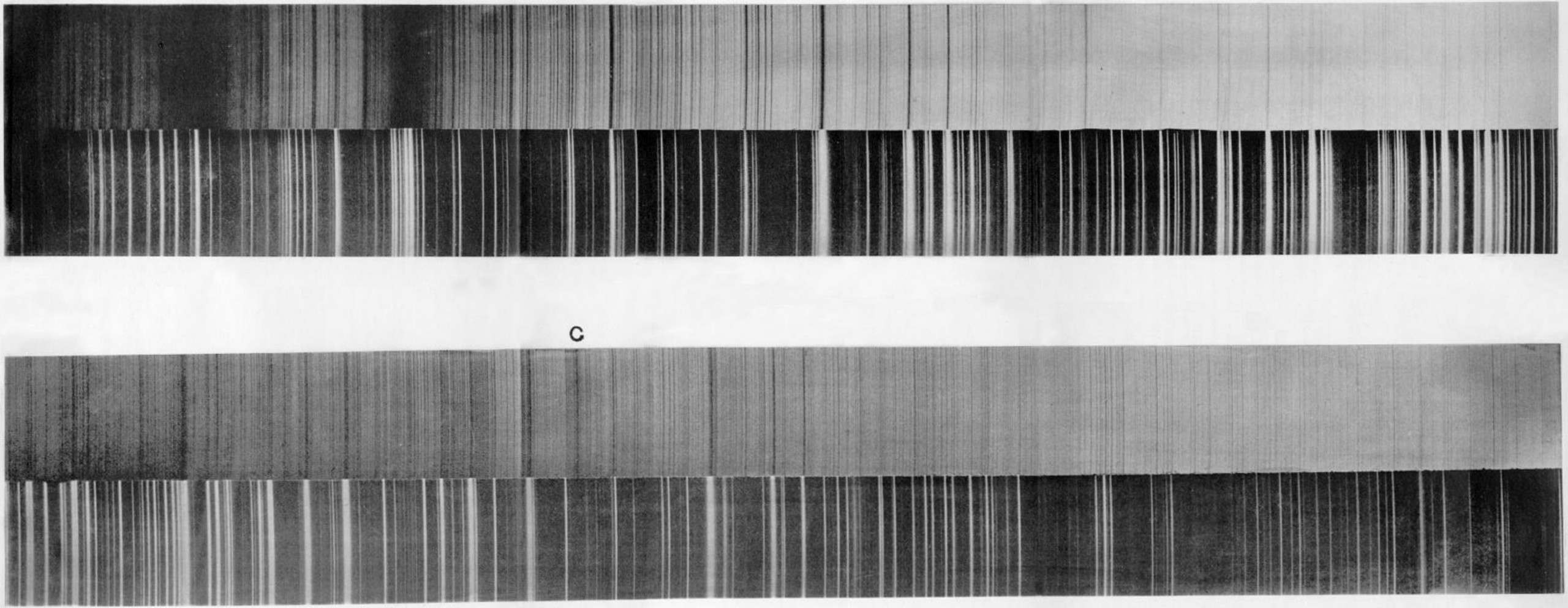
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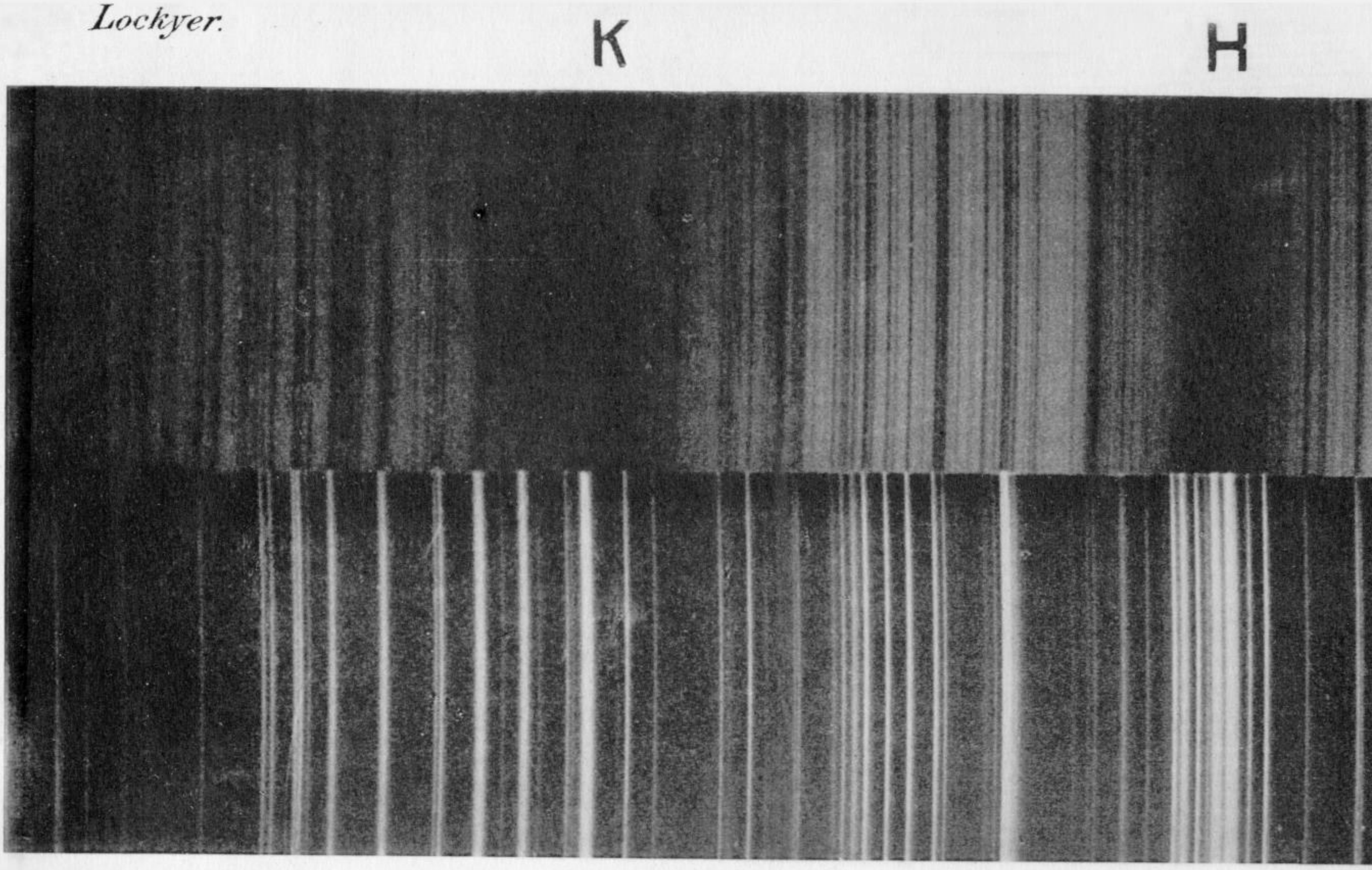

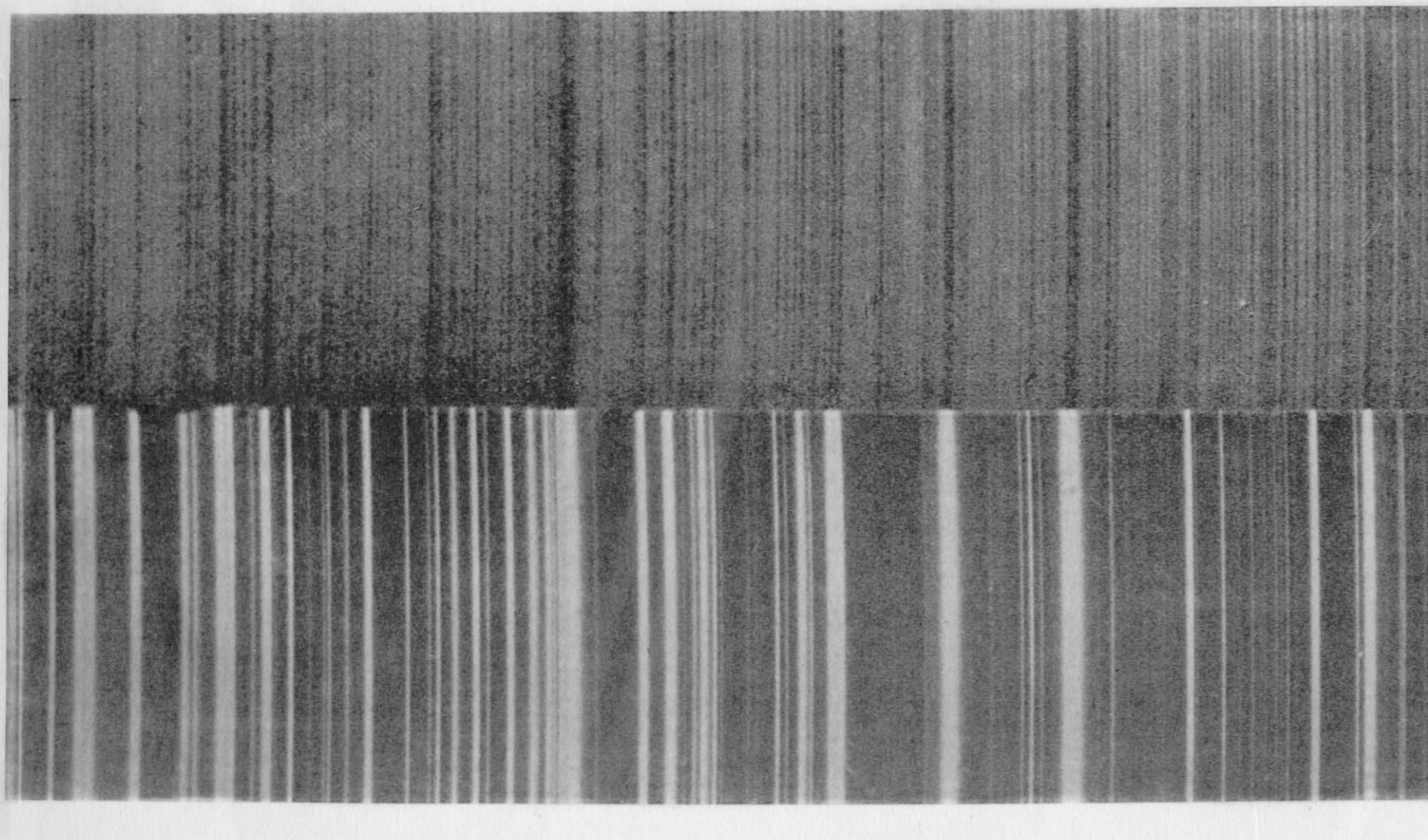

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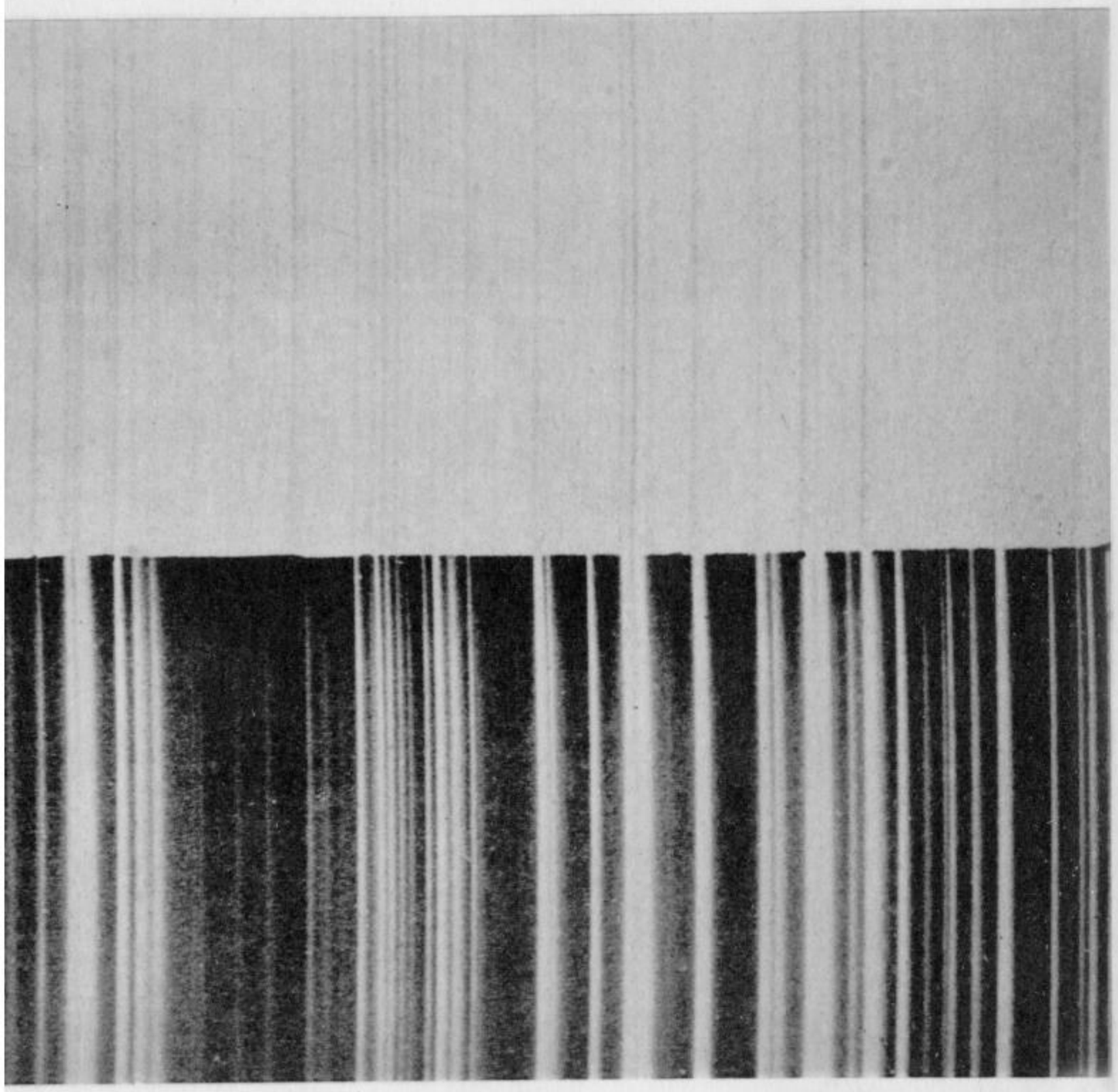

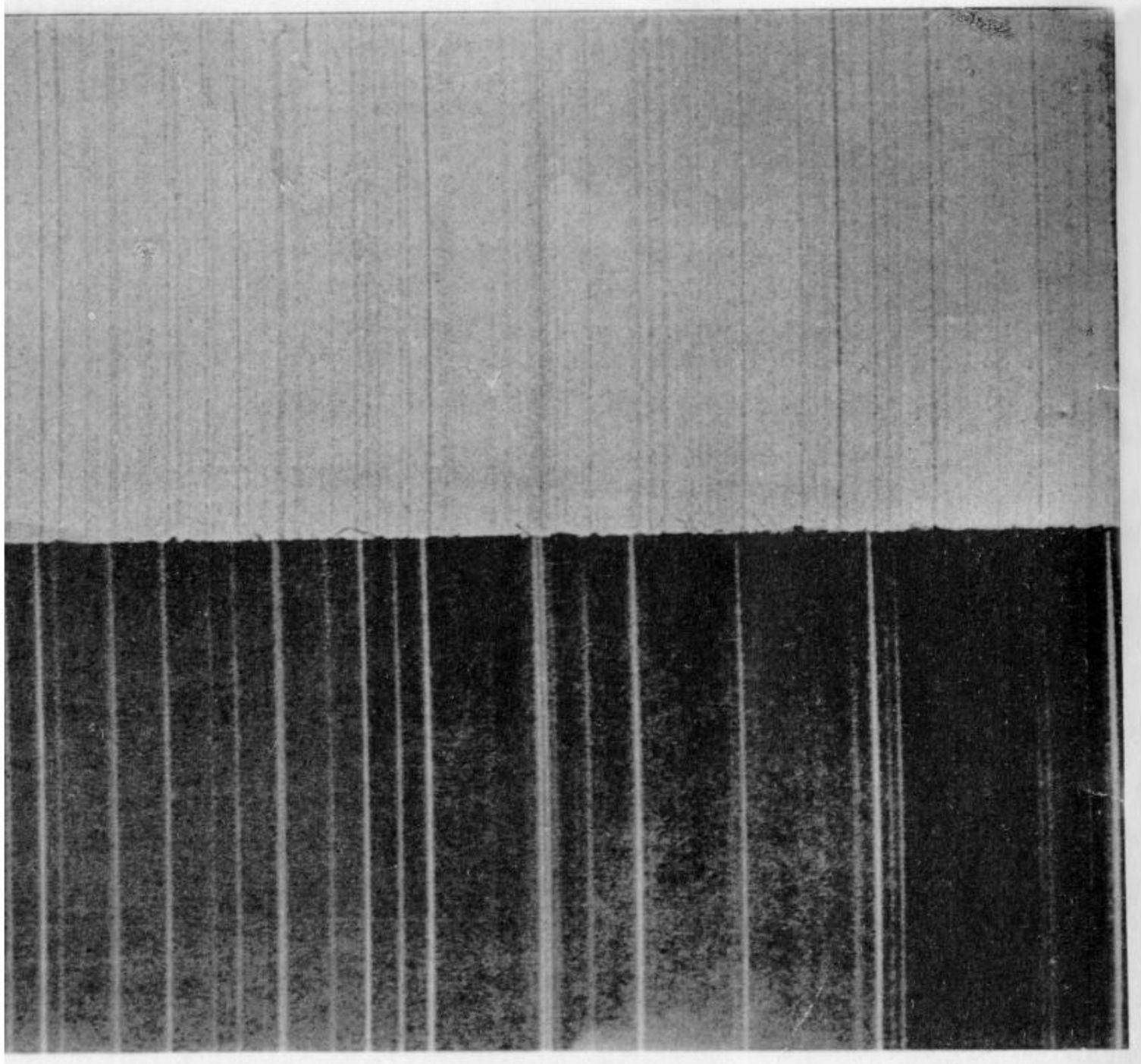

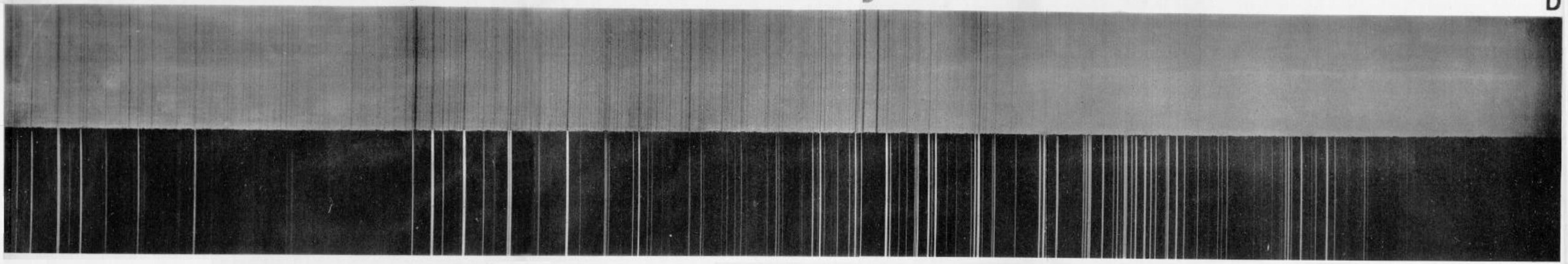
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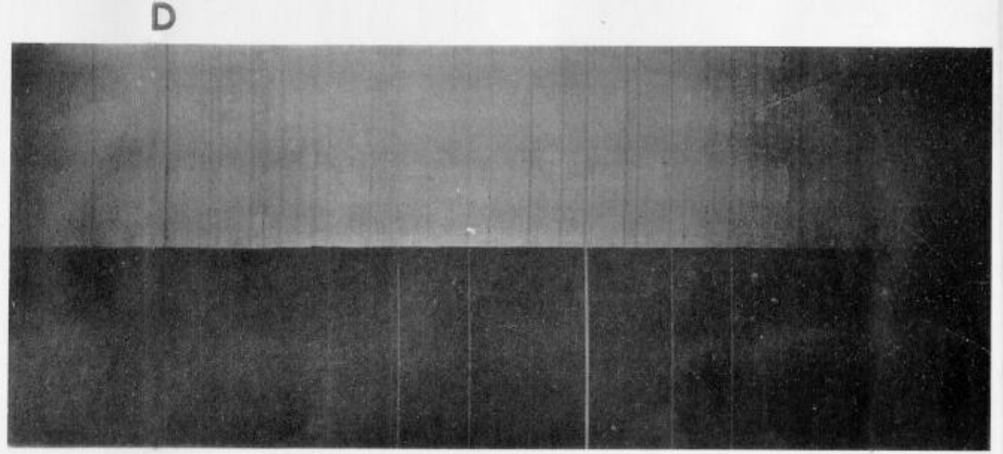
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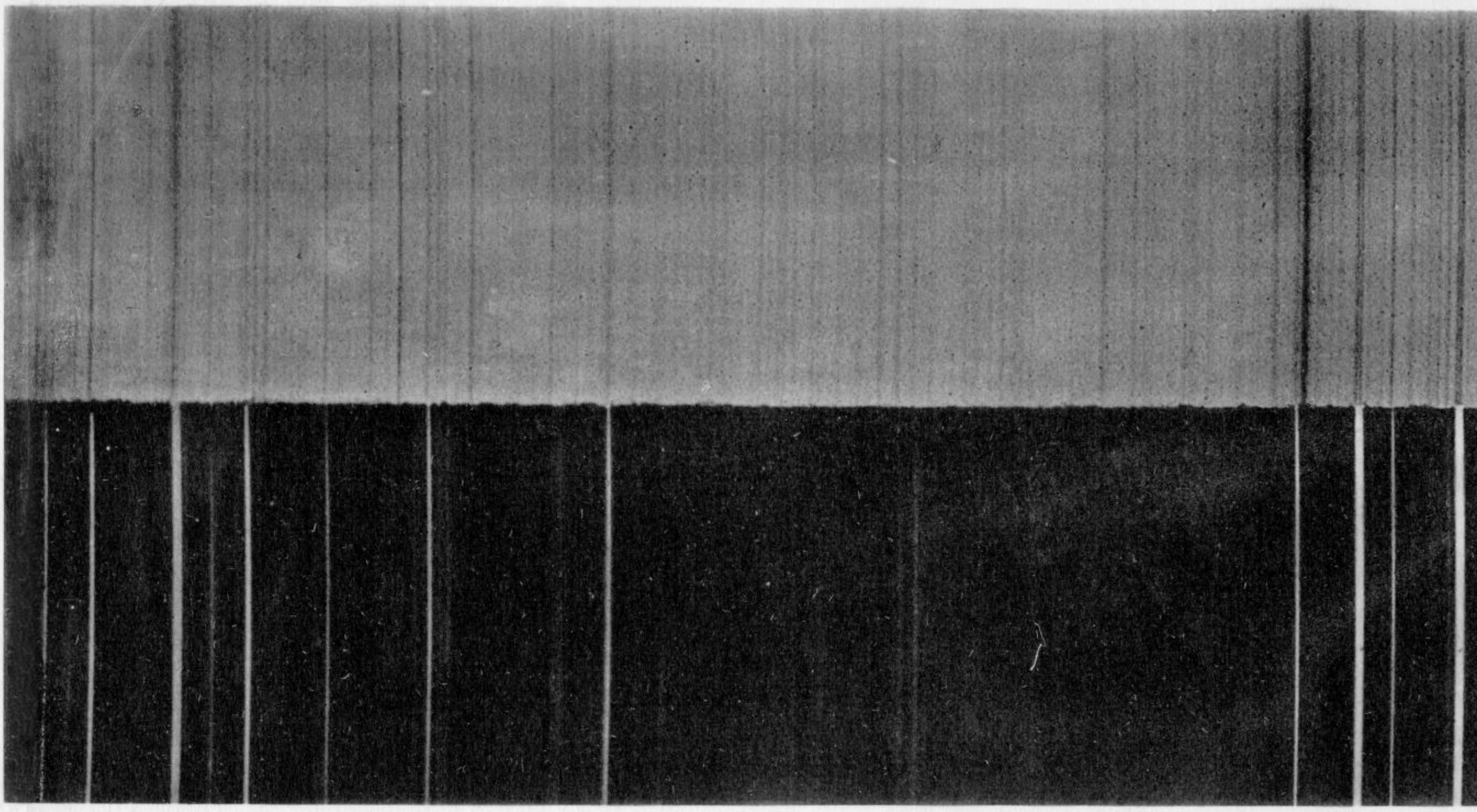

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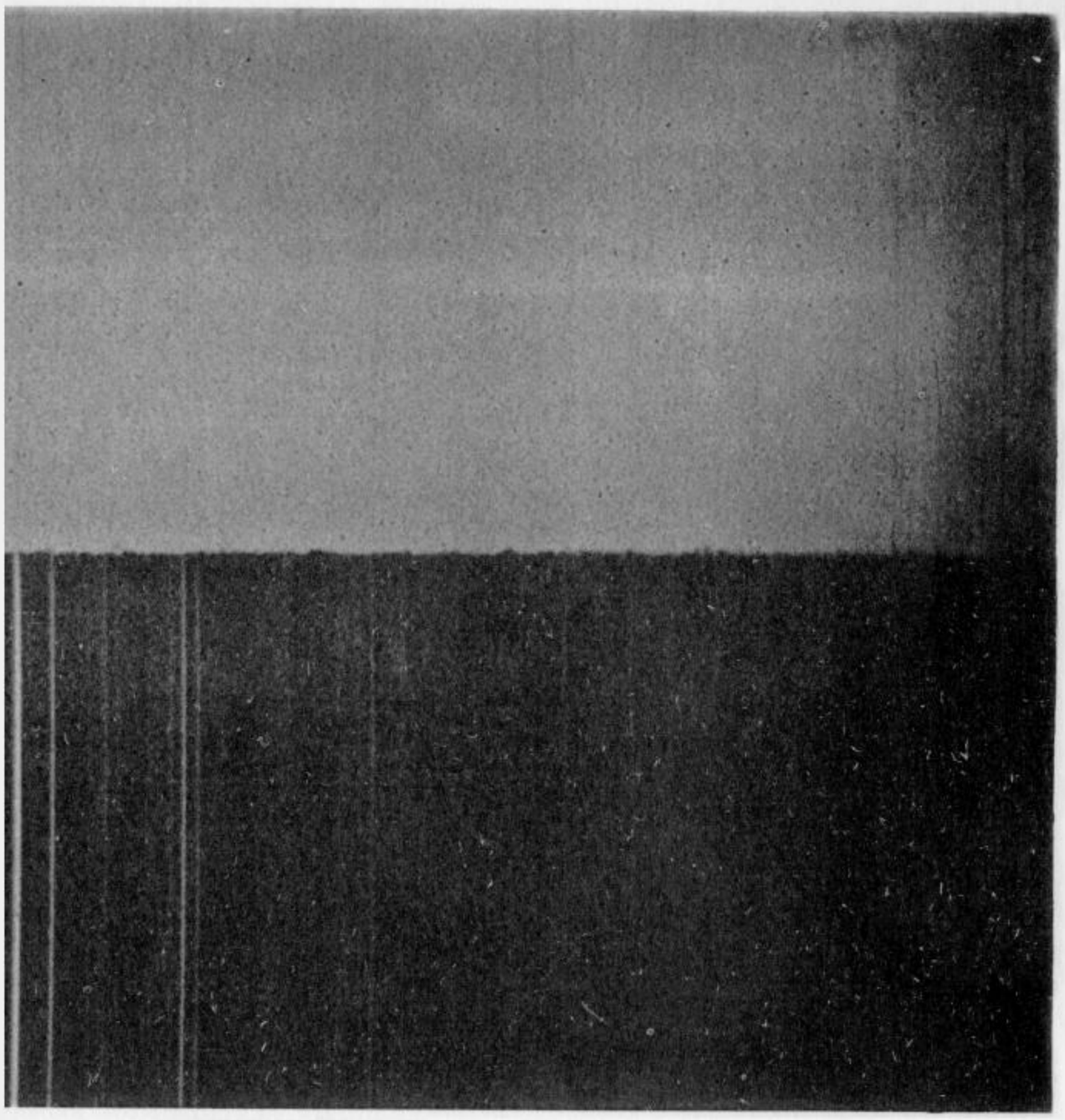
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