Bandoeng has, for a given sun's altitude, somewhat less ultraviolet than exists in Switzerland at the same elevation. Perhaps this may be explained by the lenze shape of the atmosphere, as DORNO supposes.

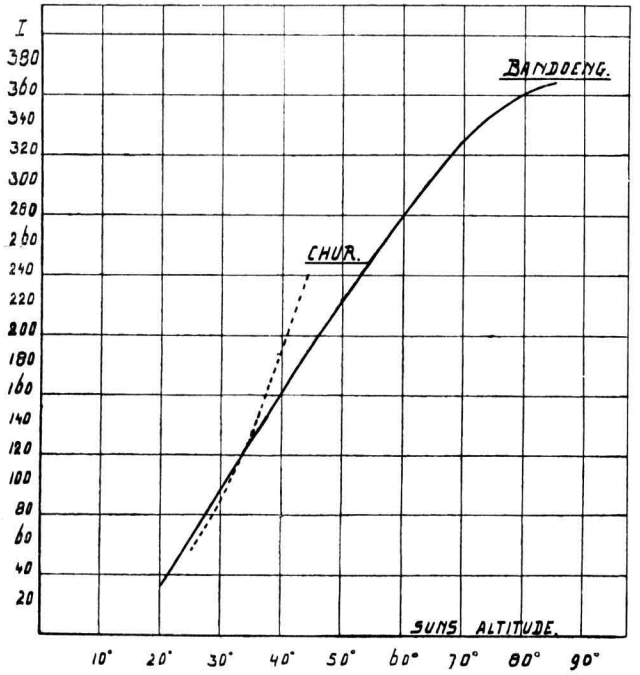

Fig. 7. Annual mean of the ultraviolet solar intensity for Bandoeng and the September mean to Chur, arranged according to solar altitude.

In conclusion we wish to express our very sincere thanks to Professor DORNO for his generous help and advice, and to Dr. MÖRIKOFER and Dr. LEVY for the great pains they have taken for the calibration of our cells.

Physics. — *On the* ZEEMAN*-effect in the arc spectrum of Nickel.* By C. J. BAKKER. (Communicated by Prof. P. ZEEMAN.)

(Communicated at the meeting of January 30, 1932.)

§ 1. *Introduction.* In his important paper on the extension of the analysis of the Nickel arc spectrum H. N. RUSSELL [1]) remarks in his conclusions, that the ZEEMAN effect in this spectrum offers an extensive field of work; it may be anticipated that many g-values will be abnormal, especially for the higher terms, but this should be important in studying the changes of coupling of the vectors which are involved.

1) H. N. RUSSELL, Phys. Rev. 34, 821, 1929.

The present paper records the ZEEMAN effect of lines in the Nickel arc spectrum, classified mostly as combinations of the lower terms in the energy scheme. It will appear that even among those terms anomalous g-values occur, obeying PAULI's well known g-sum rule.

§ 2. *On the term scheme of Ni. I.* Though more than one thousand spectral lines belonging to the Nickel arc spectrum are known, indicating its high complexity, it has been shown by the spectroscopists, who successively have worked on the analysis of this spectrum, that the structure is regular in so far that every observed term fits into the scheme predicted by HUND's theory [1].

Nickel has the atomic number 28, corresponding to the 28 electrons surrounding the Nickel nucleus. 18 of those 28 electrons form together a so-called Argon core, consisting of the completed shells $1s$, $2s$, $2p$, $3s$ and $3p$. The remaining electrons especially are of spectroscopial interest.

This communication reports the ZEEMAN effect of the strongest *Ni* arc lines, ranged from 4000 to 3000 A and being combinations of low lying term groups. These low lying term groups arise from the configurations $3d^8.4s^2$, $3d^9.4s$ and $3d^9.4p$, formed by the ten remaining electrons. The terms arising from those configurations are given in the following scheme.

Electronic configuration								Symbol	Terms	
1s	2s	2p	3s	3p	3d	4s	4p		Triplet	Singlet
2	2	6	2	6	8	2		d^8s^2	F P	G D S
2	2	6	2	6	9	1		d^9s	D	D
2	2	6	2	6	9		1	d^9p	F D P	F D P

Important intensity anomalies in the *Ni* arc spectrum are of interest [2].

§ 3. *Preceding observations on the* ZEEMAN*-effect of Nickel.* Shortly after Prof. ZEEMAN's discovery in 1896 of the influence of the magnetic field on the emission of light REESE [3] investigated the ZEEMAN effect of several metals and among them of 19 lines of Nickel. REESE's work was

[1] F. M. WALTERS, J., Wash. Ac. of Sc. **15**, 88, 1925.
K. BECHERT and L. A. SOMMER, Ann. der Phys. **77**, 351, 1925.
K. BECHERT, Ann. der Phys. **77**, 538, 1925.
W. F. MEGGERS and F. M. WALTERS, Sc. Pap. Bur. of Stand. **22**, 205, 1927.
A. C. MENZIES, Phil. Mag. **6**, 1210, 1928.
H. N. RUSSELL, loc. cit.

[2] L. S. ORNSTEIN and T. BOUMA, Phys. Rev. **36**, 679, 1930.

[3] H. M. REESE, Astr. J. **12**, 120, 1900.

continued by KENT [1]). The resolution obtained by these authors was not large. These first observations have been followed by several others, among which may be mentioned those of PETERKE [2]), GRAFTDIJK [3]), TAKAKASHI [4]) and YAMADA [5]). None of these observations however permits of fixing the g-values. LÜTTIG [6]) made measurements on lines in the visible part of the spectrum by means of an échelon transmission spectrograph. His measurement of the line 5477 agrees with that given in the present paper. In his paper on the ZEEMAN effect of the Palladium spectrum BEALS [7]) gives reproductions of the Nickel lines 3597 and 3722, both lines showing resolutions in agreement with their classification.

§ 4. *Experimental part.* The magnet used for the present investigation was the same WEISS electromagnet as used in previous investigations in Prof. ZEEMAN's laboratory [8]). The field strength has been measured in the usual way by means of the ZEEMAN effects of the Zinc triplet 4810, 4722, 4680 and of the Cadmium triplet 5086, 4800, 4679 or of the Aluminium ground doublet 3961, 3944. The field strength amounted to 40.000 Gauss.

As a light source the interrupting spark of a so called "vacuum trembler" = constructed in this laboratory by VAN DER MARK and VAN DER ZWAAL [9]) = has been used. It is a modification of BACK's well known "Abreissbogen", in such a manner that BACK's mechanical arrangement for moving the tungsten electrode has been discarded. A description has been given elsewhere [10]).

In order to excite the Nickel spectrum the fixed electrode consisted of little bars of the required small dimensions (about 25 × 2 × 2.5 mm.) sawn out of so called "Bright Ray" being mainly composed of 80 % *Ni* and 20 % *Cr.*, with impurities of *Fe*, *Cu*, etc. This "Bright Ray" has the property that the Nickel in it has lost its ferro magnetic behaviour.

The spark was produced in Hydrogen of low pressure (2 or 3 cm.) that was passing slowly through the vacuum box, enclosing the pole pieces of the magnet. In this way small leakages, which are sometimes inevitable, gave no trouble. The trembler is operated for *Ni* on 70 Volts dc.

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[1]) N. A. KENT, Astr. J. **13**, 289, 1901.
Johns Hopkins Un. circ. **20**, 82, 1901.

[2]) C. PETERKE, Halle Inaug. Diss., 1909.

[3]) J. M. GRAFTDIJK, Thesis Amsterdam, 1911.

[4]) Y. TAKAKASHI, J. Col. Sc. Tokyv **41**, Art. 8, 1921.

[5]) K. YAMADA, J. Col. Sc. Tokyv **41**, Art. 870, 1921.

[6]) O. LÜTTIG, Ann. d. Phys. **38**, 43, 1912.

[7]) C. S. BEALS, Proc. R. S. London A **109**, 369, 1925.

[8]) These Proceedings **31**, 780, 1928; **32**, 515, 1929; **32**, 565, 1929.

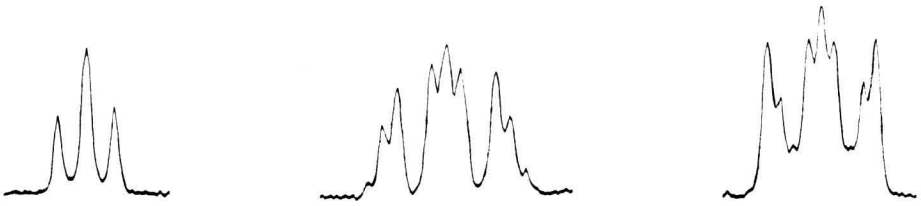
[9]) S. GOUDSMIT, J. V. D. MARK and P. ZEEMAN, Proc. R. S. Amsterdam, **28**, 127, 1925.

[10]) C. J. BAKKER, Archives Néerlandaises, serie IIIa, tome XIII, pag. 121, 1931.

A condensing quartz fluorite lens produced an image of the spark on the slit of the grating mounting.

The differently polarized components in the ZEEMAN types were separated by using a calcspar rhomb (thickness 2 cm.) placed before the quartz window of the vacuum box and giving two well separated oppositely polarized images of the spark on the slit of the grating mounting [1]).

The observations have been made with a large 6 inch Rowland grating, ruled 14.437 lines per inch and with a radius of curvature of 20 feet. The grating was in an Eagle mounting. Nearly all measurements have been made in the 3rd order, giving a dispersion of about 0.8 A/mm. Some weak lines have been measured in the 2nd order only. The duration of exposure ranged from 10 minuits for strong lines to 3 hours for the weaker lines. Fig. 1 gives photograms of the ZEEMAN effect of 3 lines, showing good



$\lambda = 3510.34$ $\lambda = 3492.97$ $\lambda = 3458.47$

Fig. 1

resolution. The photograms are made with a ZEISS photometer with an enlargement of 26 : 1.

§ 5. ZEEMAN-*Effects of Ni lines.* Table 1 includes the ZEEMAN-effects of *Ni* lines present on the plates and which are of interest to determine the g-values of the terms of the configurations $3d^9.4s$ and $3d^9.4p$. The first column gives the wave lengths in Int. Angstrom units taken from HAMM [2]). The second column denotes the classification according to RUSSELL's paper [3]). The third column gives the ZEEMAN effects, where

L = ZEEMAN effect calculated after LANDÉ's g-formula.

obs. = observed ZEEMAN effect.

calc. = ZEEMAN effect calculated with anomalous g-values.

The fourth column refers to the g-values according to LANDÉ's formula (LANDÉ) and to those which, according to well known methods, can be calculated from the observed ZEEMAN effects (obs.) [4]).

It may be noticed that a number of ZEEMAN effects have not been completely resolved. Nevertheless those unresolved types are of interest to show that the observed type is in accordance with the type calculated

1) P. ZEEMAN, Researches in Magneto-Optics, Ed. Mac. Millan, pag. 47.

2) S. HAMM, Zs. f. Wiss. Phot. 13, 105, 1914.

3) H. N. RUSSELL, loc. cit.
E. BACK IN BACK—LANDé, Zeeman-effekt und Multiplettstruktur, p. 152—184.
C. J. BAKKER, loc. cit.

TABLE I.

λ I.A.	Termcomb. x—y		ZEEMAN-effect	g_x		g_y		Remarks
				Landé.	obs.	Landé.	obs.	
5476.91	$d^{10}\ ^1S_0—d^9p\ ^1P_1$	L	(0.00) 1.00					
		obs.	(0.00) 1.01^5	%	%	1.00	1.02	1)
		calc.	(0.00) **1.02**					
3858.28	$d^9s\ ^1D_2—d^9p\ ^3F_3$	L	(**0.00**) (0.08) (0.17) 0.92 1.00 1.08 1.17 **1.25**					
		obs.	(**0.00**) **1.16**	1.00	1.01	1.08	1.08	2)
		calc.	(**0.00**) (0.07) (0.14) 0.94 **1.01** 1.08 1.15 **1.22**					
3775.56	$d^9s\ ^1D_2—d^9p\ ^3D_2$	L	(0.17) (**0.33**) 0.83 **1.00 1.17** 1.34					
		obs.	(**0.00**) **1.03**	1.00	1.01	1.17	1.03	3)
		calc.	(0.02) (**0.04**) 0.99 **1.01 1.03** 1.05					
3664.09	$d^8s^2\ ^3F_2—d^9p\ ^3P_1$	L	(**0.00**) (0.83) **0.17** 0.67 1.50					
		obs.	(**0.00**) (0.76) **0.00** 0.68	0.67	0.67	1.50	1.43	4)
		calc.	(**0.00**) (0.76) **0.09** 0.67 1.43					
3619.39	$d^9s\ ^1D_2—d^9p\ ^1F_3$	L	(**0.00**) 100					
		obs.	(**0.00**) **1.07**	1.00	1.01	1.00	1.04	5)
		calc.	(**0.00**) (0.03) (0.06) 0.98 1.01 1.04 1.07 **1.10**					
3612.73	$d^8s^2\ ^3F_2—d^9p\ ^3D_2$	L	(0.50) (**1.00**) 0.17 **0.67 1.17** 1.67					
		obs.	— (**0.73**) — **0.68 1.05** —	0.67	0.67	1.17	1.03	6)
		calc.	(0.36) (**0.73**) 0.30 **0.67 1.03** 1.39					
3610.45	$d^9s\ ^3D_2—d^2p\ ^3P_2$	L	(0.33) (**0.67**) 0.83 **1.17 1.50** 1.83					
		obs.	(0.33) (**0.67**) 0 82 **1.15 1.49** 1.83	1.17	1.15	1.50	1.49	7)
		calc.	(0.34) (**0.68**) 0.81 **1.15 1.49** 1.83					
3597.70	$d^9s\ ^3D_1—d^9p\ ^3P_1$	L	(1.00) 0.50 1.50					
		obs.	(0.93) 0.50 1.43	0.50	0.50	1.50	1.43	8)
		calc.	(0.93) 0.50 1.43					
3571.87	$d^8s^2\ ^3F_3—d^9p\ ^3F_3$	L	(0.00) 1.08					
		obs.	(0.00) 1.08	1.08	1.08	1 08	1.08	9)
3566.37	$d^9s\ ^1D_2—d^9p\ ^1D_2$	L	(0.00) 1.00					
		obs.	(**0.07**) 1.03^5	1.00	1.01	1.00	1.06	10)
		calc.	(0.05) (**0. 0**) 0.96 **1.01 1.06** 1.11					
3524.54	$d^9s\ ^3D_3—d^9p\ ^3P_2$	L	(**0.00**) (0.17) (0.33) **1.00** 1.17 1.33 1.50 1.67					
		obs.	(**0.00**) (0.15) (0.30) **1.02** 1.17 1.33 — —	1.33	1.33	1.50	1.49	11)
		calc.	(**0.00**) (0.15) (0.31) **1.02** 1.17 1.33 1.49 1.65					
3515.06	$d^9s\ ^3D_2—d^9p\ ^3F_3$	L	(**0.00**) (0.08) (0.17) **0.92** 1.00 1.08 1.17 1.25					
		obs.	(**0.00**) **1.02**	1.17	1.15	1.08	1.08	12)
		calc.	(**0.00**) (0.07) (0.14) **0.94** 1.01 1.08 1.15 1.22					
3510.34	$d^9s\ ^3D_1—d^9p\ ^3P_0$	L	(0.00) 0.50					
		obs.	(0.00) 0.50	0.50	0.50	%	%	13)
3500.85	$d^8s^2\ ^3F_3—d^9p\ ^3D_2$	L	(**0 00**) (0.08) (0.17) **0.92** 1.00 1.08 1.17 1.25					
		obs.	(**0.00**) **1.12**	1.08	1.08	1.17	1.03	14)
		calc.	(**0.00**) (0.05) (0.10) 0.98 1.03 1.08 1.13 **1.18**					
3492.97	$d^9s\ ^3D_2—d^9p\ ^3P_1$	L	(**0.00**) (0.33) **0.83** 1.17 1.50					
		obs.	(**0.00**) (0.27) **0.87** 1.15 1.43	1.17	1.15	1.50	1.43	15)
		calc.	(**0.00**) (0.28) **0.87** 1.15 1.43					

TABLE I (*Continued*)

λ I.A.	Termcomb. x—y		ZEEMAN-effect	g_x		g_y		Remarks
				Landé.	obs.	Landé.	obs.	
3483.78	$d^8s^2\ ^3F_2$—$d^9p\ ^3D_1$	L	(**0.00**) (0.17) 0.50 0 67 **0.83**					
		obs.	(**0.00**) **0.76**	0.67	0.67	0.50	0.55	16)
		calc.	(**0.00**) (0.12) 0.55 0.67 **0.97**					
3472.55	$d^9s\ ^3D_2$—$d^9p\ ^3D_3$	L	(**0.00**) (0.17) (0.33) 1.00 1.17 1.33 1.50 **1.67**					
		obs.	(**0.00**) **1.55**	1.17	1.15	1.33	1.29	17)
		calc.	(**0.00**) (0.14) 0.28) 1.01 1.15 1.29 1.43 **1.57**					
3458.47	$d^9s\ ^3D_1$—$d^9p\ ^3F_2$	L	(**0.00**) (0.17) 0.50 0.67 **0.83**					
		obs.	(**0.00**) (0.24) 0.50 0.74 **0.98**	0.50	0.50	0.67	0.74	18)
		calc.	(**0.00**) (0.24) 0.50 0.74 **0.98**					
3446.26	$d^9s\ ^3D_2$—$d^9p\ ^3D_2$	L	(0.00) 1.17					
		obs.	**0.20** **1.09**	1.17	1.15	1.17	1.03	19)
		calc.	(0.12) (**0.24**) 0.91 **1.03 1.15** 1.27					
3423.71	$d^9s\ ^3D_1$—$d^9p\ ^3D_1$	L	(0.00) 0.50					
		obs.	(0.00) 0.52[5]	0.50	0.50	0.50	0.55	20)
		calc.	(0.05) 0.50 0.55					
3414.77	$d^9s\ ^3D_3$—$d^9p\ ^3F_4$	L	(**0.00**) 0.08) 0.17) (0.25) **1.00** 1.08 1.17 1.25 1.33					
		obs.	(**0.00**) **1.16** [**1.42** 1.50	1.33	1.33	1.25	1.25	21)
3392.99	$d^9s\ ^3D_3$—$d^9p\ ^3D_3$	L	(0.00) 1.33					
		obs.	(**0.00**) **1.30**[5]	1.33	1.33	1.33	1.29	22
		calc.	(0.04) (0.09) (**0.13**) 1.20 1.25 **1.29 1.33** 1.38 1.42					
3391.05	$d^8s^2\ ^3F_4$—$d^9p\ ^3F_4$	L	(0.00) 1.25					
		obs.	(0.00) **1.25**	1.25	1.25	1.25	1.25	23)
3380.58	$d^9s\ ^1D_2$—$d^9p\ ^1P_1$	L	(0.00) 1.00					
		obs.	(**0.00**) **1.01**	1.00	1.01	1.00	1.02	24)
		calc.	(**0.00**) (0.01) **1.00** 1.01 1.02					
3369.58	$d^8s^2\ ^3F_4$—$d^9p\ ^3D_3$	L	(**0.00**) (0.08) (0.17) (0.25) **1.00** 1.08 1.17 1.25 1.33					
		obs.	(**0.00**) **1.19** [1.42 1.50	1.25	1.25	1.33	1.29	25)
		calc.	(**0.00**) (**0.04**) (0.08) (0.12) **1.13** 1.17 1.21 1.25 1.29 [1.31 1.37					

REMARKS.

1) Sharp triplet. In 2nd order only.

2) Shows correct type. In 2nd order only.

3) Sharp triplet. In 2nd order only.

4) Observed σ-comp. 0.00 is clearly enlarged. In 2nd order only.

5) Shows correct type.

6) In 3rd order the strong π-comp. 0.73 could be measured only. Both the obs. π-comp. have been measured in 2nd order.

7) In 3rd order all π-comp. and two strongest σ-comp. could be measured. In 2nd order all σ-comp. are present.

8) Sharp sextet.

9) Sharp tpiplet.

10) All components are enlarged.

11) Well resolved type. The weakest σ-comp. could not be measured.

12) Shows the correct type.

13) Sharp triplet. See Fig. 1.

14) Shows the correct type.

15) Well resolved type. See Fig. 1.

16) Weak in 3rd order.

17) Shows the correct type. Weak in 3rd order.

18) Well resolved type. See Fig. 1.

19) All components are enlarged.

20) Rather sharp triplet.

21) Shows the correct pseudo-triplet type.

22) All components are enlarged.

23) Sharp triplet.

24) Sharp triplet.

25) Shows the correct pseudo-triplet type.

with the aid of the g-values determined from other combinations. The line 3500.85 $d^8.s^2\ ^3F_3$—$d^9.p\ ^3D_2$ is an example of this. The ZEEMAN effect calculated according to LANDÉ's formula would show σ-components, if unresolved, with decrease of intensity to the outside. The ZEEMAN effect calculated by means of $g = 1.08$ for $d^8.s^2\ ^3F_3$ and $g = 1.03$ for $d^9.p\ ^3D_2$, both g-values determined from other lines, shows σ-components, if unresolved, with decrease of intensity to the inside. The latter is really observed. Secondly it sometimes is possible to deduce from an unresolved type, if the g-value of one of the combining terms is known, the g-value of the other term with considerable accuracy [1]).

In the spectral region investigated separations less than 0.15 times the normal magnetic separation distance could not be resolved, so causing the observed g-values in most cases to have an uncertainty of 0.01.

The last column in table 1 contains the remarks to the observed types. If an observed and unresolved type is in accordance with the calculated type, as to decrease of intensity in the components it is remarked that it shows the correct type. If the ZEEMAN effect of a line has been observed in the 2nd order only it is especially noted.

It is well known that the ZEEMAN effect can show whether a spectral line is masked by another one. This is clearly observed in the *Ni* spectrum for the lines 3674.11, 3548.19 and 3433.57. These lines are also given in RUSSELL's list with double interpretation.

§ 6. *Table II and III include the terms of the configurations $d^9.s$ and $d^9.p$.* For those configurations the g-values of the whole set of terms could be determined. The relative termvalues, given in column 2, refer to a value 0.00 for the term $d^8.s^2\ ^3F_4$, which is the lowest lying term in the Nickel arc spectrum. The absolute term values can be obtained by adding 61579 to the relative term values in accordance with RUSSELL's datum of the ionisation potential of *Ni* I (7.6 Volts).

TABLE II.

Term	Relative term value	Term difference	g-values	
			LANDÉ	Observed
$d^9s\ ^3D_3$	204.82	675.00	1.333	1.33
$d^9s\ ^3D_2$	879.82	833.29	1.166	1.15
$d^9s\ ^3D_1$	1713.11		0.500	0.50
$d^9s\ ^1D_2$	3409.95		1.000	1.01

[1]) A. G. SHENSTONE and H. A. BLAIR, Phil. Mag. 8, 765, 1929.

TABLE III.

Term	Relative term value	Term difference	g-values	
			LANDÉ	Observed
$d^9p\ ^3P_2$	28569.30		1.500	1.49
		931.45		
$d^9p\ ^3P_1$	29500.75		1.500	1.43
		691.55		
$d^9p\ ^3P_0$	30192.30		0/0	0/0
$d^9p\ ^3F_4$	29480.96		1.250	1.25
		—160.21		
$d^9p\ ^3F_3$	29320.75		1.083	1.08
		1298.65		
$d^9p\ ^3F_2$	30619.40		0.666	0.74
$d^9p\ ^3D_3$	29668.89		1.333	1.29
		219.58		
$d^9p\ ^3D_2$	29888.47		1.166	1.03
		1024.40		
$d^9p\ ^3D_1$	30912.87		0.500	0.55
$d^9p\ ^1F_3$	31031.02		1.000	1.04
$d^9p\ ^1D_2$	31441.64		1.000	1.06
$d^9p\ ^1P_1$	32982.30		1.000	1.02

A quantum mechanics perturbation theory may be applied, according to LAPORTE and INGLIS [1]), to the terms of the configuration $d^9.s$. From the position of the terms the g-values $g\,^3D_2 = 1.152$ and $g\,^3D_1 = 1.015$

TABLE III. Configuration $(3d)^9\,4s$.

(SL) coupling			Ni I	(JJ) coupling	
Term		Calc. g-value	Obs. g-value	Calc. g-value	Structure
J = 3	$^3D_3$	1.333	1.33	1.333	$-d_{5/2} + s_{1/2}$
J = 2	$^3D_2$	1.166	1.15	1.100	$-d_{5/2} + s_{1/2}$
	$^1D_2$	1.000	1.01	1.066	$-d_{3/2} + s_{1/2}$
		+	+	+	
	g-sum	2.166	2.16	2.166	
J = 1	$^3D_1$	0.500	0.50	0.500	$-d_{3/2} + s_{1/2}$

[1] O. LAPORTE and D. R. INGLIS, Phys. Rev. **35**, 1340, 1930.

are calculated. The experimental g-values are in good agreement with these calculated values as may be seen from table II.

In table III and IV the terms are arranged in such a way that terms of equal value of the total impulse moment J are grouped together. According to PAULI's g-sum rule one expects that the sum of the g-values of the terms of such a group is independent of the coupling which is involved. Therefore this sum must be equal to the sum of LANDÉ's g-values for these terms. It is seen that within the experimental errors this rule holds very well.

The last column shows the g-values calculated for (JJ) coupling. The structure has been taken from MACK [1]), who derived it from the compa-

TABLE IV. Configuration $(3d)^9\,4p$.

(SL) coupling			Ni I	(JJ) coupling	
Term		Calc. g-value	Obs. g-value	Calc. g-value	Structure
J = 4	$^3F_4$	1.250	1.25	1.250	$-d_{5/2} + p_{3/2}$
J = 3	$^3F_3$	1.083	1.08	1.111	$-d_{5/2} + p_{1/2}$
	$^3D_3$	1.333	1.29	1.239	$-d_{5/2} + p_{3/2}$
	$^1F_3$	1.000	1.04	1.066	$-d_{3/2} + p_{3/2}$
	g-sum	3.416	3.41	3.416	
J = 2	$^3P_2$	1.500	1.49	1.289	$-d_{5/2} + p_{1/2}$
	$^3F_2$	0.666	0.74	1.211	$-d_{5/2} + p_{3/2}$
	$^3D_2$	1.166	1.03	0.766	$-d_{3/2} + p_{1/2}$
	$^1D_2$	1.000	1.06	1.066	$-d_{3/2} + p_{3/2}$
	g-sum	4.332	4.32	4.332	
J = 1	$^1P_1$	1.000	1.02	1.100	$-d_{5/2} + p_{3/2}$
	$^3P_1$	1.500	1.43	0.834	$-d_{3/2} + p_{1/2}$
	$^3D_1$	0.500	0.55	1.066	$-d_{3/2} + p_{3/2}$
	g-sum	3.000	3.00	3.000	
J = 0	$^3P_0$	0/0	0/0	0/0	$-d_{3/2} + p_{3/2}$

1) J. E. MACK, Phys. Rev. 34, 17, 1929.

rison of the iso electronic systems *Ni* I, *Cu* II, *Zn* III, *Ga* IV and *Ge* V. For *Ni* I the g-values interpose between the LANDÉ g-values and those calculated according to (JJ) coupling, as may be seen from the tables.

The author is indebted to Prof. ZEEMAN for his interest and advice during this investigation.

Laboratory "Physica" of the University.

Amsterdam, Jan. 1932.

Physics. — *An X-ray Investigation of the n-mono-alkyl malonic Acids.* By D. COSTER and A. v. d. ZIEL. (Communicated by Prof. J. G. VAN DER CORPUT.)

(Communicated at the meeting of January 30, 1932.)

As is well known, several series of organic compounds (fatty acids, paraffines) when investigated by *X*-rays, show the existence of a long spacing which increases proportionally to the number of *C*-atoms in the molecule. Very often in those compounds a phenomenon of alternation has been observed: the spacing of the molecules with an odd number of *C*-atoms not lying midway between the spacings of the adiacent molecules with an even number of *C*-atoms, but those with an even number as well as those with an odd number of *C*-atoms forming a series of their own. Also as regards other properties: melting point, solubility, heat of combustion, analogous alternating phenomena have been observed [1]).

Prof. VERKADE at Rotterdam proposed us to investigate by means of *X*-rays a series of *n*-mono-alkyl malonic acids used in his own work in order to make sure in how far a parallelism between the change in grating constant in this series and other properties investigated by him exists.

The work was done with a vacuumspectrograph of a slightly modified type. The crystal table was fixed to the cover of the spectrograph. This cover turned with a cone on the body of the spectrograph, its position could be read on a scale with a vernier. The distance from the slit to the axis of the spectrograph or from the axis to the photographic plate was 6,18 cm. The preparation was brought in a thin sheet on a glass strip which was fixed on the crystal table. The thin sheet was made by first dissolving the substance in water (the lower members of the series) or in alcohol, aceton or ether (the higher members) and pouring a little of the solution on the glass strip. The thickness of the sheet which remained after

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[1]) See e.g. P. E. VERKADE, H. HARTMAN and J. COOPS, Rec. trav. chim. Pays Bas. **45**, 373, 1926.

P. E. VERKADE, J. COOPS and H. HARTMAN, ibidem **45**, 545, 1926.

P. E. VERKADE and J. COOPS, ibidem **46**, 903, 1927.

P. E. VERKADE and J. COOPS, ibidem **49**, 568, 1930.