LETTERS TO THE EDITOR

ON THE FLAME SPECTRUM OF CuCl

THE purpose of this note is to report the observation of some new bands of CuCl which have been found while studying the flame spectrum of this salt with quite a different objective.

The spectrum of CuCl is rather easily excited in the flame and has been studied by a number of workers. The more recent work is due to Ritschl[1] who has measured a large number of bands between λ 5506 and λ 3997 A. These bands have been arranged into 5 different systems, usually denoted as systems A, B, C, D and E with their 0,0 bands at λ 5262, λ 4882, λ 4847, λ 4354 and λ 4333 A, respectively.

In course of the present investigation of the flame spectrum of CuCl, bands have been observed to as low wavelengths as λ 3500 A. The CuCl flame was obtained by burning asbestos thread, wound over an iron ring and soaked into the solution of the salt in water, over a Bunsen burner. A specially built large aperture quartz spectrograph, with dispersion nearly the same as that of the small quartz spectrograph supplied by Adam and Hilger, was used to photograph the bands. Besides the CuCl bands in the regions noted by other workers, some more bands were observed at lower wavelengths. Their measurements are given in the table below, and since the dispersion employed was very low, they will be correct only upto ± 3 A. The reason why they were not previously observed is probably that the spectrographs used were not fast enough to record these faint bands.

TABLE I

Some additional CuCl bands in flame

λ_{air} (A.)	$\nu_{vac.}$ (cm.$^{-1}$)	v', v''	$\nu_{vac.}$ (calc.)	λ_{air} (A)[2]
4005	24960	8, 3	24963	4010
3950	25310	9, 3	25325	3945
3890	25700	10, 3	25694	3885
3835	26070	11, 3	26061	3835
3785	26415	12, 3	26420	3785
3735	26770	13, 3	26780	
3685	27130	14, 3	26136	
3570	28005			
3490	28645			

It is difficult to say whether the new bands belong to one of the old systems or they form a new system by themselves. They are, however, found to fit in quite well with system E of Ritschl, and a tentative assignment of their vibrational quantum number is also given in the table. They seem to represent the heads of the sequences $\Delta v = 5$ to 11. Other members of the sequences could not probably be resolved at this low dispersion. Column 4 of the table gives $\nu_{vac.}$ for the calculated positions of these bands and in view of the low dispersion employed, the agreement does not seem unsatisfactory. Lord Rayleigh and Fowler[2] who studied the spectrum of this salt excited by active nitrogen, also observed a few bands in this region ; their measurements are given in the last column of the table.

Science College, Patna,
S. P. SINHA.
May 29, 1948.

1. Ritschl, R., *Z. Phys.*, 1927, **42**, 172. 2. Lord Rayleigh and Fowler, A., *Proc. Roy. Soc.*, A, 1911, **86**, 105.

SQUARES OF NUMBERS

IN the June 1947 issue of the *Current Science* (Vol. **16**, No. 6, pp. 178–79) Azizuddin Ahmad Siddiqi addressed a letter to the Editor explaining "A New Method of Obtaining Squares of Numbers". Though there is nothing very much new in the method, it simply seems to have been an attempt at popularising its use as "*a simple and ready method*" It may, however, interest your readers to know that the method sponsored is only a special case of the gereral rule for the multiplication of any two numbers, and that even the general rule itself can be presented in a much simpler manner. This is best illustrated by an actual numerical example below: Suppose two numbers 2,734,681 and 64,537 are to be multiplied. There are 7 digits in one and 5 in the other. In order that they may have equal digits add two zeros to the left of 6 in the second number and write them down one below the other as under :

```
X=      2734681
Y=      0064537
        -------
              7......first row
             59
            71
           90
         101
        150
       102
       77
      56
     50
    12
    -----------
Z=  176488107697
```

The process begins with the multiplication of the two units place digits in the two numbers X and Y. Put this result down below in the first row. Cross-multiply the units and tenths place digits in X and Y and put down their sum one place to the left in the second row. Next cross-multiply the units, tenths, and hundredths place digits in X and Y and similarly put down the sum of the three sub-products two places to the left in the third row, and so on. The continued process of further cross-multiplication and summation is self-explanatory. In all, there will be $p+q-1$ rows obtained from the original number of p digits in X and q digits in Y. When this process is complete, add up the digits in the units places in the several rows to obtain the units places digit in the final product number Z, and so on for all the other place digits with the system of carry-over being observed. The result Z will be the final product required.

It is easy to explain the method described above in the language of algebra as below. Remembering that any positive integral number having $k+1$ digits can always be expressed in a series form as

$$a_0+10a_1+10^2a_2+10^3a_3+\ldots\ldots+10^ka_k$$

the product of two such series

$$a_0+10a_1+10^2a_2+10^3a_3+\ldots\ldots+10^ka_k$$
$$x_0+10x_1+10^2x_2+10^3x_3+\ldots\ldots+10^mx_m,$$

where $m\leqslant k$ has been obtained in all standard text-books on algebra as

$$a_0x_0+10\,(a_0x_1+a_1x_0)+ 10^2(a_0x_2+a_1x_1+a_2x_0)+\ldots\ldots +10^m\,(a_0x_m+a_1x_{m-1}+\ldots\ldots+a_mx_0)+\ldots\ldots +10^{m+r}\,(a_rx_m+a_{r+1}\,x_{m-1}+\ldots\ldots+a_kx_{m+r-k}) +\ldots\ldots+10^{m+k}a_kx_m$$

where r assumes all positive integral values up to $r=k$. The reason for placing the various sums in the different rows in the illustrative example above in the manner explained is at once obvious from the last algebraic expression obtained for the product of two numbers.

Statistics Branch, C.W.I.N.C., New Delhi,
G. M. PANCHANG.
R. V. VISWANATHAN.
April 23, 1948.

MANGANESE CHLORIDE EMISSION BANDS

EXCITING the vapour of manganese chloride in a heavy current discharge from a 2,000 volt D. C. Generator through a continuously evacuated quartz tube with hollow cylindrical electrodes, a characteristic band system attributed to the diatomic molecule MnCl is obtained between λ3900–λ3500 consisting of seven well-separated marked close sequences of violet degraded bands. The bands have, in part, a line-like appearance and have subsidiary components, besides the chlorine isotopic heads. Pearse and Gaydon[1] have made a brief mention of bands ascribed to this molecule by Mesnage from a study of High Frequency discharge through MnCl. Only the first members of three sequences are reported. A much more extensive system has been obtained by the author and the vibrational analysis has led to the following constants, $\omega_e'=412{\cdot}0$ and $\omega_e''=384{\cdot}1$, the anharmonic constants being very small. The chlorine isotopic shifts completely support the analysis. Details will be published elsewhere.

Andhra University, Waltair,
P. TIRUVENGANNA RAO.
June 25, 1948.

1. Pearse and Gaydon, "Identification of Molecular Spectra," 1941, 136.