The reason for the different behaviour of the old and new samples was found to be that the latter contained less oxygen. When the oxygen concentration of the new sample was increased to that of the previous ones, the green phosphorescence disappeared. Thus the essential condition for the appearance of the phosphorescent band initiated by the green auroral line is that oxygen is present in extremely small concentrations. The green luminescence showed an afterglow, sometimes lasting for a few seconds.

In the experiments with the *solidified* gases, previously referred to, the solid layers unavoidably contained traces of oxygen, and it is therefore very likely that the green N_1-band, which in neon had the wave-length 5577·4, is a phosphorescence phenomenon initiated by the green auroral line. In solidified systems a red band N_3 (6320) was observed, which might be initiated by the red auroral O I-doublet (6300·3, 6364).

In the case of gaseous argon we have not yet observed a red band corresponding to the red O I-doublet.

Investigations into the nature of this phosphorescence phenomenon, detected by Mr. Nordhagen in gaseous argon containing traces of oxygen, will be continued.

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Some New Ferromagnetic Manganese Alloys

THE ferromagnetic beta phases in the systems copper–manganese–aluminium and copper–manganese–tin have been shown to have an ordered body-centred cubic structure, and the compositions of alloys showing maximum magnetizations correspond to atomic proportions[1,2] Cu_2MnAl and Cu_2MnSn. Valentiner has recently reported that ferromagnetic alloys exist in the system copper–manganese–indium. The highest intensity of magnetization is shown by the composition Cu_2MnIn, and the structure is analogous to that[3] of Cu_2MnAl and Cu_2MnSn.

The position of gallium in the periodic table relative to aluminium, indium and tin, and the similarity of the equilibrium diagrams of the binary systems copper–aluminium, copper–tin, copper–indium and copper–gallium suggest that a ferromagnetic beta phase might exist in the ternary system copper–manganese–gallium.

We have investigated three copper–manganese–gallium alloys having the following compositions (Table 1).

Table 1

Alloy designation	Weight per cent Cu	Mn	Ga
*G*1	49·5	21·6	28·9
*G*2	62·3	13·0	24·7
*G*3	57·8	16·0	26·2

Specimens of alloy *G*1 quenched from temperatures between 500° C. and 750° C. all showed a two-phase structure under the microscope, and were very feebly magnetic. The highest intensity of magnetization was shown by a specimen quenched from 650° C. This specimen had a saturation magnetization at room temperature of about $2\frac{1}{2}$ per cent of that of nickel. This value was doubled on ageing the specimen at 100° C. for 110 hours. The composition of alloy *G*1 corresponds to atomic proportions $Cu_{1.97}Mn_{1.00}Ga_{1.05}$.

Alloys *G*2 and *G*3 were quite strongly magnetic after being quenched from 750° C., and under the microscope had an acicular appearance like martensite. Alloy *G*3 had a saturation intensity of magnetization at room temperature about seven-tenths of that of nickel. Cooled slowly from 750° C., this alloy became non-magnetic, and microscopic examination showed that a transformation had taken place. Ageing of alloy *G*3 at 100° C. and 200° C., following quenching from 750° C., caused a reduction in saturation magnetization; but no transformation was apparent under the microscope.

Table 2. X-ray diffraction data for alloy *G*3 (quenched from 750° C.)

Radiation	Intensity	*d*	Radiation	Intensity	*d*
FeKα	ww	2·446	FeKβ	ww	1·328
β	ww	2·294	α	m	1·335
α	m	2·286	β	ww	1·292
β	ww	2·122	α	s	1·295
α	s	2·127	α	s	1·207
β	m	2·019	α	w	1·148
α	ss	2·018	α	m	1·135
α	m	1·968	α	ss	1·108
α	m	1·556	α	m	1·076
α	m	1·532	β	w	1·062
α	m	1·371	α	m	1·067
			α	w	1·011

X-ray diffraction photographs were taken at room temperature of powder specimens, quenched from 750° C., of alloys *G*2 and *G*3. Both patterns were of the same type, and the data for alloy *G*3 are listed in Table 2. A satisfactory interpretation of these data could not be made. The lines observed cannot be reconciled with those to be expected from the beta structure, ordered or unordered. Weibke states that the beta copper–gallium alloys resemble beta copper–aluminium alloys in that the structure of quenched alloys depends upon the cooling velocity[4]. The same behaviour was noted by Hume-Rothery and Raynor[5]. The martensitic structures observed in quenched alloys could possibly be derived from the beta phase, stable at high temperature, but not retained by quenching.

Preliminary experiments have shown that ferromagnetic phases exist in the binary systems manganese–germanium and manganese–indium, and in the ternary system copper–manganese–germanium. Investigation of these systems is being extended with the view of identifying the ferromagnetic carriers. It is also suggested that ferromagnetic phases might exist in the binary system manganese–gallium.

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