The only assumption relative to induced magnetism which is involved in these equations is, that if a magnetic force X due to external magnetism produces in the iron of the ship an induced magnetization, and if this induced magnetization exerts on the compass needle a disturbing force whose components are X', Y', Z', then, if the external magnetic force is altered in a given ratio, the components of the disturbing force will be altered in the same ratio.

It is true that when the magnetic force acting on iron is very great the induced magnetization is no longer proportional to the external magnetic force, but this want of proportionality is insensible for magnetic forces of the magnitude of those due to the earth's action.

Hence, in practice we may assume that if a magnetic force whose value is unity produces through the intervention of the iron of the ship a disturbing force at the compass-needle whose components are a in the direction of x, d in that of y, and g in that of z, the components of the disturbing force due to a force X in the direction of x will be aX, dX, and gX.

If therefore we assume axes fixed in the ship, so that x is towards the ship's head, y to the starboard side, and z towards the keel, and if X, Y, Z represent the components of the earth's magnetic force in these directions, and X', Y', Z' the components of the combined magnetic force of the earth and ship on the compass-needle,

$$\left.\begin{aligned} X' &= X + aX + bY + cZ + P, \\ Y' &= Y + dX + eY + fZ + Q, \\ Z' &= Z + gX + hY + kZ + R. \end{aligned}\right\} \qquad (1)$$

In these equations a, b, c, d, e, f, g, h, k are nine constant coefficients depending on the amount, the arrangement, and the capacity for induction of the soft iron of the ship.

P, Q, and R are constant quantities depending on the permanent magnetization of the ship.

It is evident that these equations are sufficiently general if magnetic induction is a linear function of magnetic force, for they are neither more nor less than the most general expression of a vector as a linear function of another vector.

It may also be shewn that they are not too general, for, by a