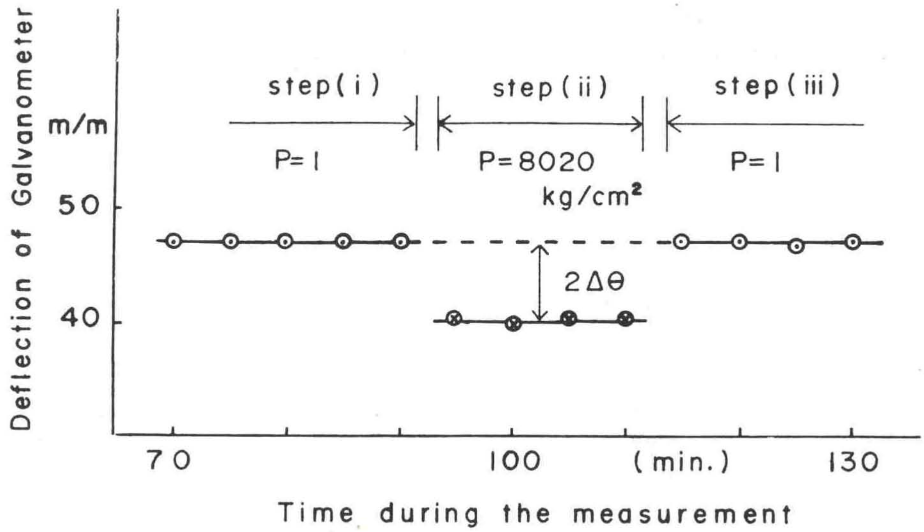

Fig. 3. A practical example of the results for obtaining $\Delta\Phi'_s$.
(Specimen Ni, Temperature $-73°C$ and magnetic field 5,100 Oe)
step (i): before the pressure is applied.
step (ii): under an applied pressure 8020 kg/cm^2.
step (iii): after the pressure is released.
Between the step (i) and (ii) the pressure is applied and between the step (ii) and (iii) the pressure is released.

so that a stabilized measurement was successfully accomplished in the whole course.

The measurement of Φ'_s itself, required to get the pressure coefficient of Φ'_s, $\Phi'^{-1}_s(\Delta\Phi'_s/\Delta p)$, has been made in the same magnet using a search coil with 100 turns. The effective diameter and length of the coil are just the same as those of the coil C_a used in the measurement of $\Delta\Phi'_s$, in order to make the measurements of Φ'_s and $\Delta\Phi'_s$ in the same condition.

The measurements of $\Delta\Phi'_s/\Delta P$ and Φ'_s have been done at $-73°C$, $0°C$ and several points in a range from $0°C$ to $100°C$. The former two temperatures are obtained with stirring fans by the mixture of powdered dry ice and ethyl alcohol and that of erashed ice and water, respectively. The latter several constant temperatures were maintained in an oil bath with stirring fans and with a non-inductive heater (H in Fig. 1) made of nichrome wire, which was mounted at the bottom of the bath, as shown in Fig. 1.

The compressibility necessary for deriving the pressure effect on σ_s has also been measured at the same temperatures. This measurement was done with a compressimeter developed by Tatsumoto et al.[19)]

Pressure effect on the saturation flux

The saturation flux Φ_s due to the saturation magnetization M_s in a specimen magnetized to saturation may ideally be picked up in a search coil wound directly on the cylindrical specimen of infinite length and is given by

$$\Phi_s = 4\pi M_s q n \tag{1}$$

with

$$M_s = D\sigma_s \tag{2}$$

Here, q, D and n are the cross sectional area, the density of the specimen and the total turn number of the coil, respectively. In this case, the cross sectional area q of the specimen may be assumed to be that of the search coil since the coil is wound directly, unless the thickness of the coil is large.

On differentiating Eq. (1) with respect to pressure p, the following familiar relation is obtained

$$\sigma_s{}^{-1}(\partial\sigma_s/\partial p) = \Phi_s{}^{-1}(\partial\Phi_s/\sigma p) - K/3, \tag{3}$$

where K is the volume compressibility of the specimen $-(1/V)\ (dV/dp)$, and $\sigma_s^{-1}(\partial\sigma_s/\partial p)$ and $\Phi_s^{-1}(\partial\Phi_s/\partial p)$ are pressure coefficient of σ_s and Φ_s, respectively. The second term $K/3$ in the right-hand side is derived from the pressure derivatives of both the cross sectional area q and the density D of the specimen, and this is evidently just equal to the linear compressibility of the specimen.

The measurement of the saturation flux is made practically by employing a specimen of finite length. Therefore, the search coil picks up not only Φ_s, but also a field inverse to the applied one, which is produced by the free magnetic poles appearing at both the ends of the specimen. Hereafter, this inverse field is called an apparent demagnetizing field, in a sense of the demagnetizing field generally used. The observed saturation flux Φ'_s picked up by a search coil with cross sectional area A is therefore given by

$$\Phi'_s = 4\pi M_s q n - N M_s A n, \tag{4}$$

where the intensity of the apparent demagnetizing field is assumed to be proportional to M_s everywhere in A, so that it may formally be represented with a proportional constant N, as NM_sAn.

In the case of $A=q$, the constant N introduced here is the so-called demagnetizing constant and is a function of only the dimension of the specimen. In a general case where $A>q$, N is a function of the dimensions of both the specimen and the coil; in other words, N has a constant value for the specimen and the coil given. The value of N, however, becomes smaller as the specimen gets longer in length.

By using Eq. (4), the pressure coefficient of σ_s in Eq. (3) is expressed as