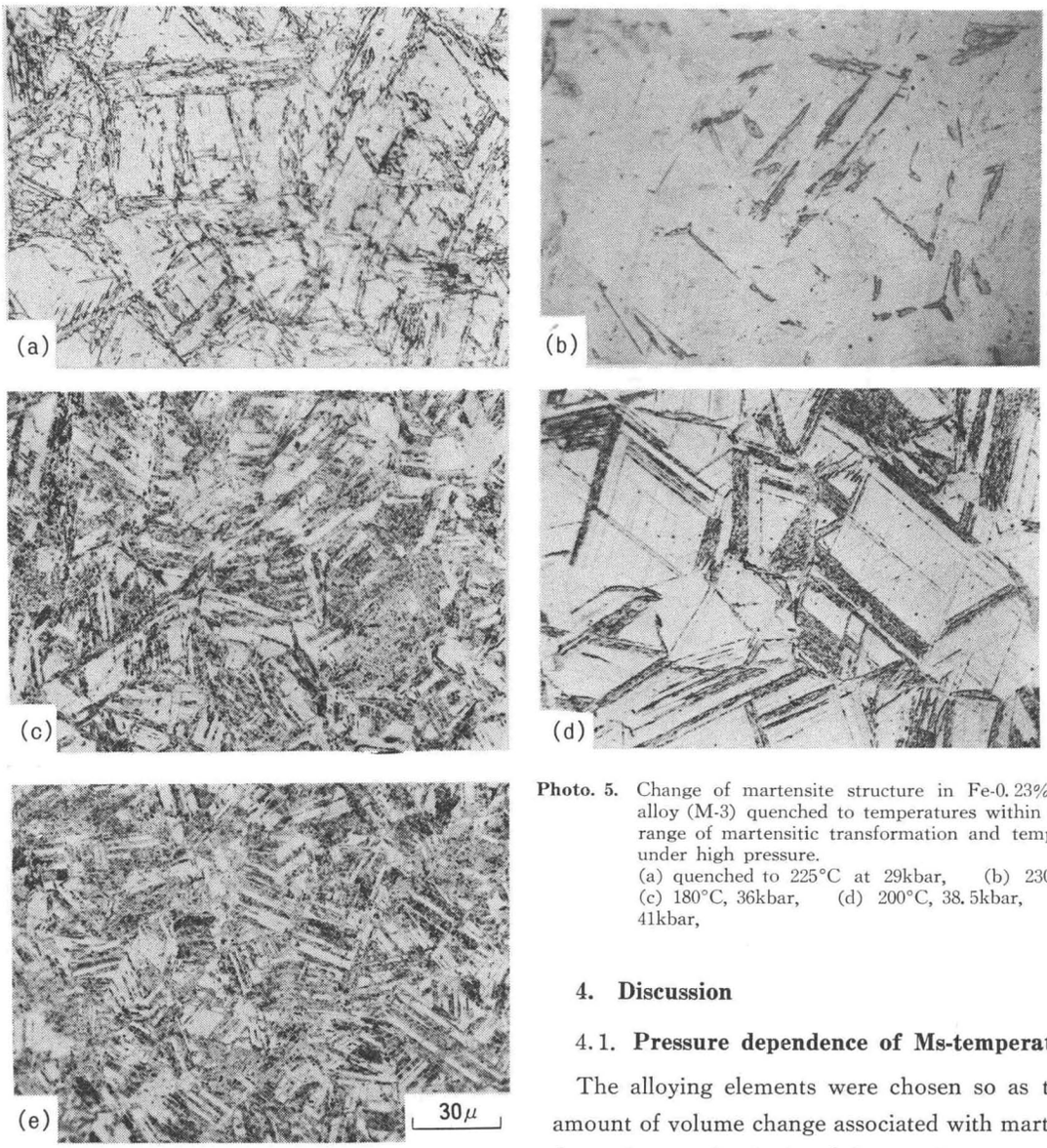

Photo. 5. Change of martensite structure in Fe-0.23%C-1.37%Mn alloy (M-3) quenched to temperatures within an expected range of martensitic transformation and tempered 300°C under high pressure.
(a) quenched to 225°C at 29kbar, (b) 230°C, 33kbar, (c) 180°C, 36kbar, (d) 200°C, 38.5kbar, (e) 150°C, 41kbar,

under high pressure. Namely, when the pressure increases from 1 atm to 29 kbar, in the alloys containing carbon more than 0.3%, Ms-temperature above 350°C depresses to 280°C and also microhardness of approximately 530 HV increases to 700 HV, while no change of the hardness was observed by pressurizing to 38.5 kbar. On the other hand, with the depression of Ms-temperature, the microhardness increases about 25 HV per 10 kbar, in the alloys containing carbon less than 0.3%. Consequently, the depression of Ms-temperature with an increase of pressure is closely connected with the changes of the martensite structure followed by the increase of hardness.

4. Discussion

4.1. Pressure dependence of Ms-temperature

The alloying elements were chosen so as to vary the amount of volume change associated with martensite transformation on the basis of the results reported by Kenneford.[14] But, in spite of the difference in the kind or amount of the alloying element, the lowering tendency of the Ms-temperature was almost the same, that is approximately 40°C/10 kbar in all alloys. The reason can be considered as follows. As to be understood from the equation (1) and (2), the pressure dependency of Ms-temperature may be affected by the volume change in the formation of martensite. It is considered that this volume change will not only depend on transformation temperature but also on the kind and amount of alloying element.

Namely, this volume change increases with lowering of the temperature which is resulted from the defference in thermal-expansion-coeffcient between γ phase and marten-

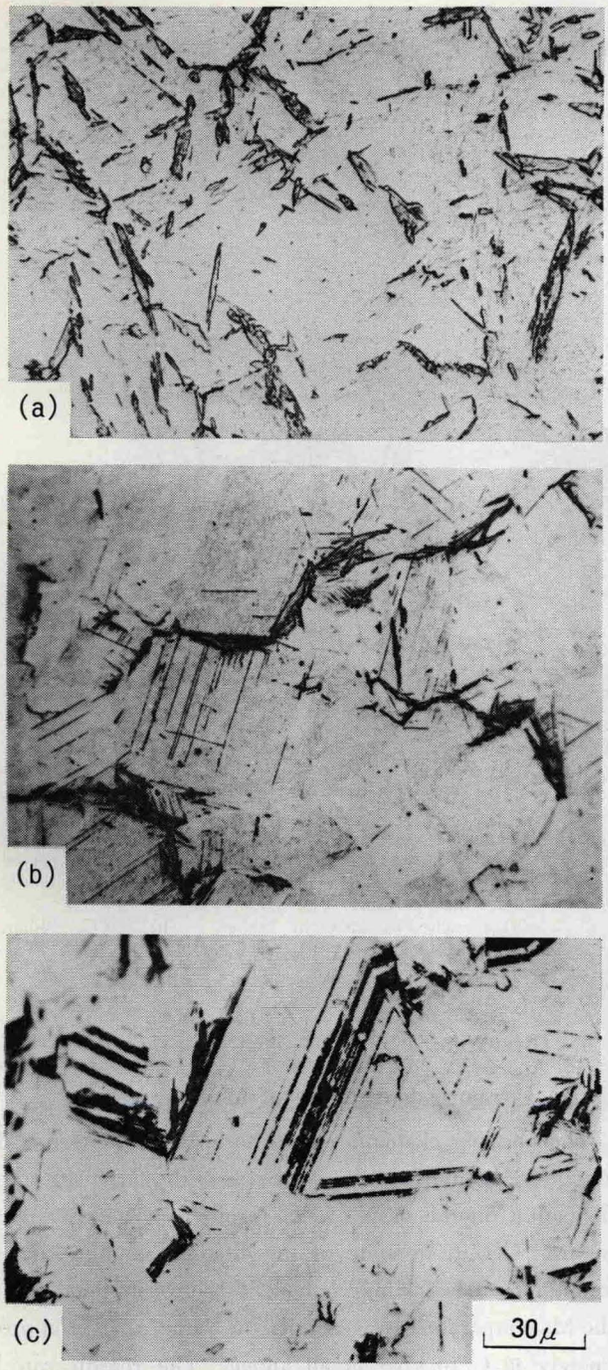

Photo. 6. Effect of pressure on microstructure of martensite in Fe-0.37%C-1.60%Cr alloy (C-3) quenched to various temperatures and then tempered under high pressure.
(a) quenched to 210°C at 29kbar, (b) 160°C, 38.5kbar, (c) 150°C, 41kbar,

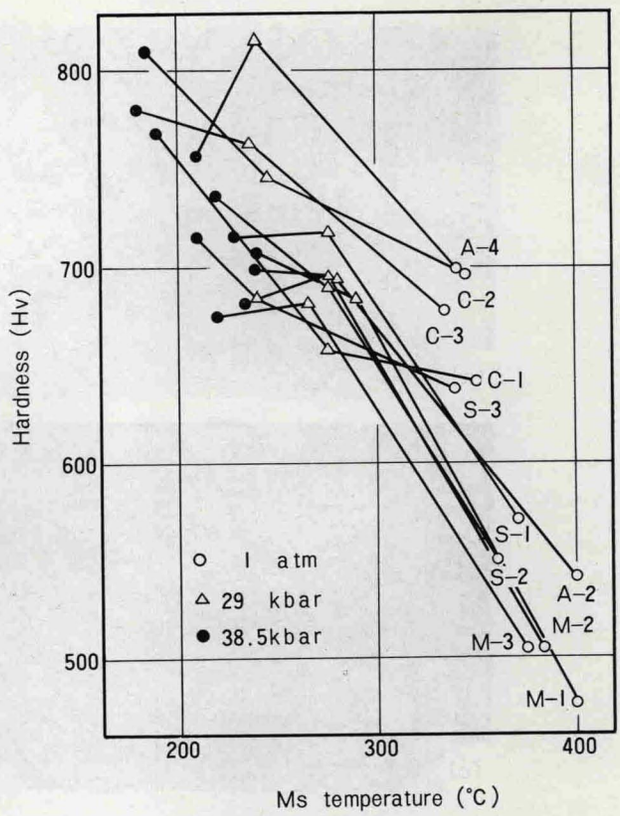

Fig. 4. Effect of pressure on martensite structure in some alloys.

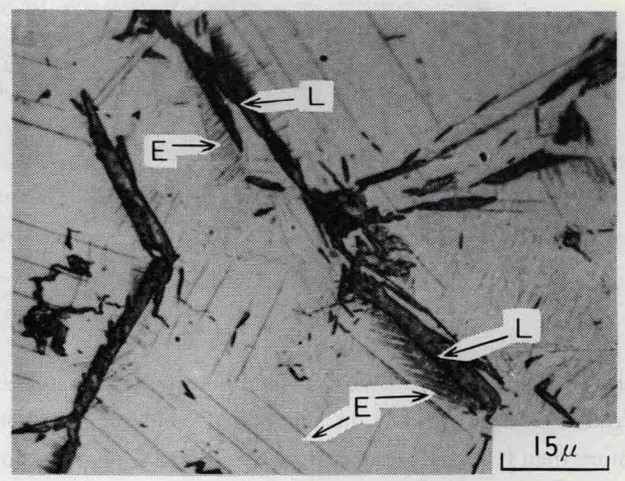

Photo. 7. Mixed structure of lenticular (L) and plate-like (E) martensite in Fe-0.35%C-1.51%Si alloy (S-3) quenched to 150 °C and tempered for at 300°C for 2min 41kbar.

site. However, no investigation was carried out on this change in the alloys used. If this change is similar to the difference in the volume between γ and α phases in iron caused with a decrease of temperature, it is assumed that this effect is stronger than that by alloying element, as the volume change increases with the depression of Ms-temperature. Consequently, it is thought that the effect of alloying element on the pressure dependency of Ms-temperature was not significantly observed.

4.2. Process of martensite transformation

The boundaries of γ, α and ε phases in the P-T diagram of pure iron are indicated in **Fig. 6** with the lines of T_0