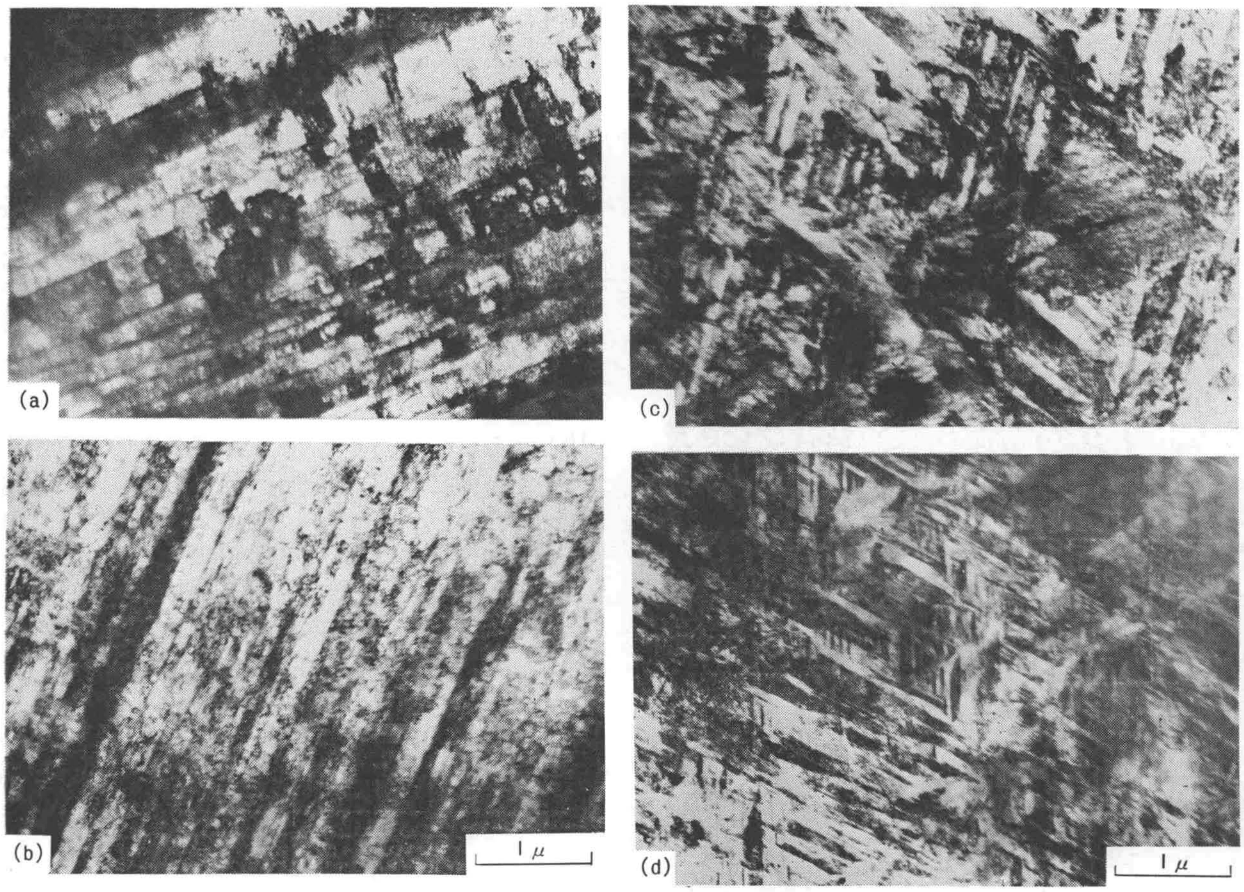


**Photo. 3.** Transmission electron micrographs of plate-like martensite in Fe-0.23%C-1.37%Mn alloy (M-3) quenched to 200°C and tempered at 300°C for 2min at 38.5kbar.
(a) and (b) Tempered region (c) and (d) Martensite formed from untransformed austenite.

### 3.2. Martensite structure

The optical micrographs of martensite structure in the alloys, containing carbon less than 0.3%, quenched from austenitized temperature under various pressures are shown in **Photo. 1.** The gradual change from packet structure (a) to plate-like one (b) by the increase of the pressure can be seen. On the other hand, in the alloys containing carbon more than 0.3%, the mixed structure of packet and lenticular is shown at the atmospheric pressure and nearly the lenticular structure at 29kbar and further at 38.5kbar the mixed structure of lenticular and plate-like is observed. The transmission electron microstructure of martensite changes from the lath to the twin type by pressrizing as shown in **Photo. 2.** This fact is in an agreement with the results reported by Vyhnal et al.[22] The plate-like structure observed with an optical microscope is similar to one which was already reported in Fe-Cr alloys[8] under high pressure and Fe-Mn alloy[23] at atmospheric pressure, as shown in **Photo. 3.**

As it is very difficult to discuss in detail the change of the martensite structure obtained by quenching under high pressure, the change is mainly estimated from the tempered martensite, which is obtained by the same method as to measure Ms-temperature. The results are shown in **Photos. 4, 5, 6, 7** and 8. **Photo. 4** shows the tempered structure of primary martensite in Fe-0.28%C alloy (A-4) quenched to the vicinity of Ms-temperature. In this photograph, the change from packet structure to plate-like one can be observed with an increase of pressure, and at 41 kbar fully plate-like structure. **Photo. 5** shown the structural changes in Fe-0.23%C-1.37%Mn alloy (M-3) as well as those shown in **Photo. 4.** The observation, it shows that the pressure at which the plate-like structure appeared was lowered by the addition of Mn to approximately 36 kbar, which was lower than that in the Fe-0.28% alloy, It is likely that decrease in this pressure relates to the

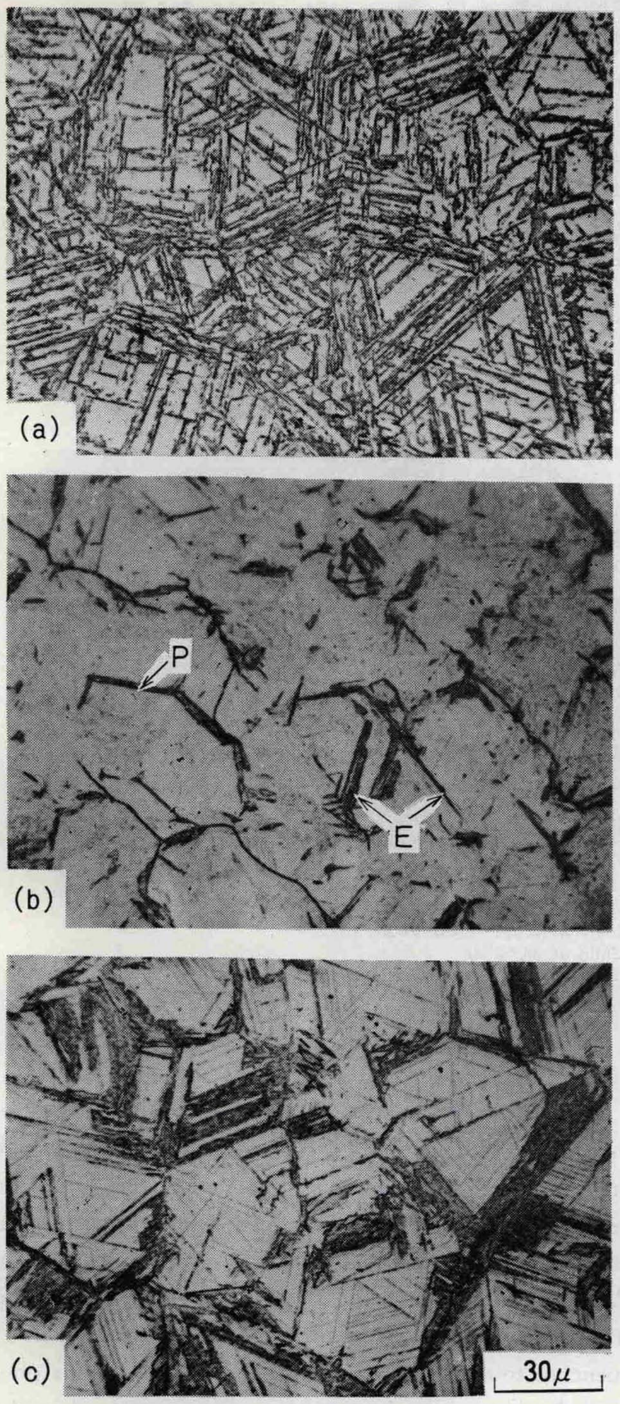


**Photo. 4.** Effect of pressure on martensite microstructure in Fe-0. 28 %C alloy (A-2).
(a) Packet structure (P), quenched to 230°C at 29kbar.
(b) Packet (P) and plate-like (E) structures quenched to 220°C at 38.5 kbar. (c) Plate-llke structure (E), quenched to 180°C at 41kbar

lowering of the stacking fault energy and of the free energy of ε phase by the addition of Mn. Consequently, this fact is due to the depression of pressure at which the $\gamma \rightarrow \varepsilon'$ transformation occurs.

**Photo. 6** shows the structural changes from packet to plate-like through the mixed structure of lenticular and plate-like martensites in Fe-0. 37%C-1. 60%Cr alloy (C-3). In the alloys containing carbon more than 0. 3%, the plate-like structure is easy to distinguish metallographically from the other structure. The reason for this may relate to the difference in habit plane between structures observsd with change of carbon content.[24)25)] Therefore, as the difference in the growth direction or habit plane between plate-like and lenticular structures is observed as shown in **Photo. 7,** these structures are easily distinguishable. However, the distinction between the packet and plate-like structures was difficult, because they have the same habit plane.

**Photo.** 8 shows the change of martensite structure in Fe-0. 42% and Fe-0. 35%C-1. 51%Si alloys, quenched to various temperatures below the Ms-temperature at 38.5 kbar. The plate-like structure is observed around the lenticular structure. It is also observed that the volume fraction of plate-like structure increases with the depression of the transformation temperature, but no change was observed on the volume fraction of the lenticular structure.

The martensite structures obtained in the alloys containing maximum amount of alloying element at high pressures are summarized in **Fig. 4.** The classification of martensite structure at latm in this figure was performed by observing the specimens water-quenched with an optical microscope and with a transmission electron microscope, because the Greninger-Troiano's method could not be applied at latm.

3. 3. **Hardness of martensite structure**

The structural change of the martensite in a specimen with an increase of pressure occurs as described before. It is predicted that the mechanical property is influenced by the appearances of martensite structure. As the specimen size was not large enough to enable us to examine the various mechanical properties, only microhardness was measured on the specimens quenched under various pressures. **Fig. 5** shows the relationship between the microhardness and Ms-temperature, in low alloys. In this figure, it is indicated that with the depression of Ms-temperature or with an increase of pressure, the microhardness increases in all the alloys. The results are divided into two groups by carbon content in the alloys, which has a significant effect on the structural change of martensite