Physics. — *Recovery and recrystallization viewed as processes of dissolution and movement of dislocations.* (Concluding part.) By W. G. BURGERS. (Laboratorium voor Physische Scheikunde der Technische Hoogeschool, Delft.) (Communicated by Prof. J. M. BURGERS.)

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III, 6. *Occurrence of "stimulated" crystals.*

We shall conclude this paper by discussing one other remarkable pecularity deduced from the analysis of the forms of crystals in recrystallized aluminium plate. This refers to the presence of such "pointed" crystals as shown at *B* in fig. 18. From the analysis by SANDEE (62) and MAY (63) it follows that such crystals did not start to grow from their nucleus until another crystal (the "surrounding" crystal *A*), the growth of which

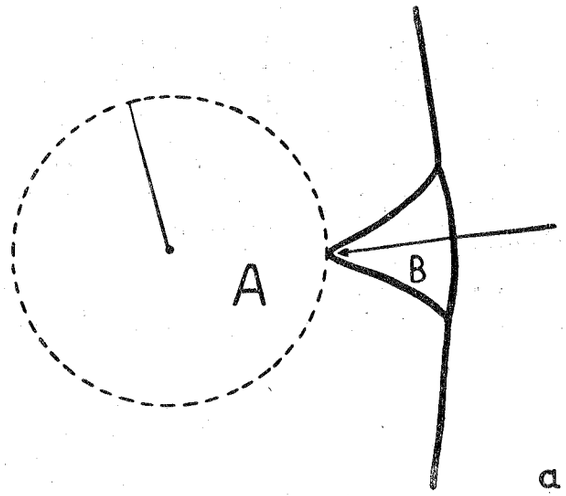

Fig. 19a. Formation of a "stimulated" crystal: Crystal *B* did not start to grow from its nuclear spot (indicated by the arrow) before crystal *A* had attained a size indicated by the circle with radius *r*.

had started previously, had come into contact with it in a way as described in fig. 19. In a discussion of this phenomenon (70) we have spoken in this connection of "stimulation" of growth of crystal *B* by crystal *A*. In order that the stimulated crystal obtains a measurable size, its rate of growth must be larger than that of the stimulating crystal. It was also found that both stimulating and stimulated crystals had a mutual orientation as found in spinel twins, that is they have a (111) plane and a (110) direction in common. As this plane and direction are those of preferential gliding in aluminium, it was suggested that the action of stimulation might be caused by something like a "discharge" of the stresses in the nucleus, which might take place by movement of dislocations along the common glide plane, at the moment that contact was established.

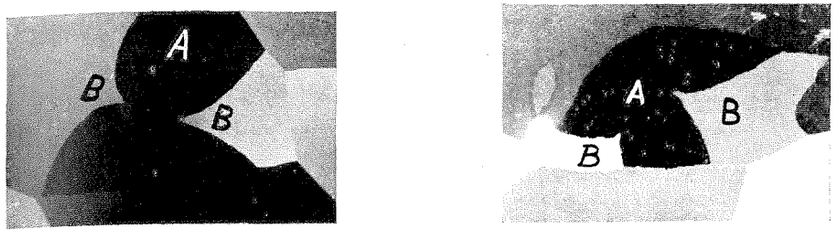

Fig. 18. Examples of stimulated crystals in recrystallized aluminium plate: the pointed crystals *B* have been "stimulated", in the sense as described in fig. 19a, by crystal *A*. Natural size.

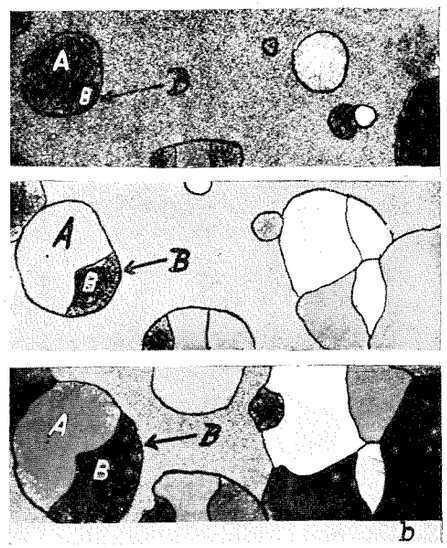

Fig. 19b. Formation of a "pointed" crystal in aluminium (cf. Fig. 19a). Natural size.

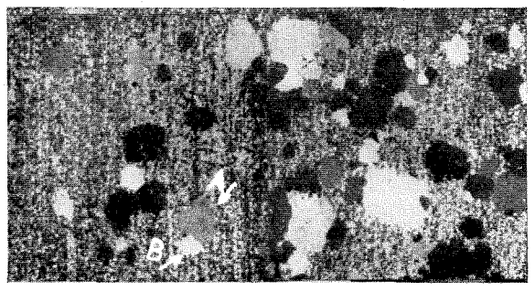

Fig. 21. Occurrence of "pointed" ("stimulated") crystals in the recrystallization experiments of ANDERSON and MEHL (10): it is highly probable that the pointed crystallite *B* (white on the reproduction) is "stimulated" by the growing crystal *A* (grey on the reproduction) (After ANDERSON and MEHL (10)). Magnif. about 7 ×.

The occurrence of stimulated crystals, which seems very common in recrystallized aluminium and which gives rise to most remarkable orientation relationsships, is still a subject of closer investigation [33]). Here, however, we mention this remarkable effect only in connection with some recent results, obtained by ANDERSON and MEHL (10) in their investigation of the recrystallization of thin aluminium sheet. From the increase of the

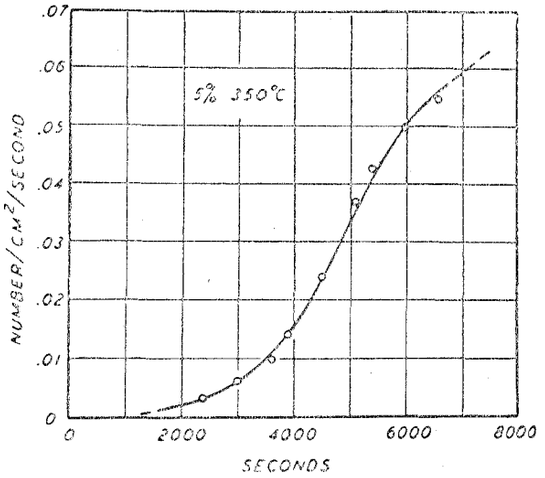

Fig. 20. Rate of nucleation N (number of grains formed per cm² of the unrecrystallized matrix per second) as a function of time of heating in isothermal recrystallization of thin aluminium sheet (350° C, 5.1 % elongation). *N is seen to increase in the course of the recrystallization process* (after ANDERSON and MEHL (10)).

recrystallized fraction and of the number of new crystallites as a function of time of heating these authors deduced that, whereas the rate of growth of the new crystallites remained constant with time (in agreement with for example fig. 12), the rate of nucleation (that is the number of new grains formed per cm² of the unrecrystallized matrix per second) *increased* with time, at least in finegrained material [34]). This is shown in fig. 20. With regard to this result ANDERSON and MEHL remark that the observed curve appears autocatalytic in nature and that such an auto-acceleration would appear to argue for an action at a distance; that is, that the occurrence and growth of one nucleus should transmit through the unrecrystallized matrix an accelerating stimulus to nucleation. Viewed in the light of the "stimulated" crystals discussed above, the actual occurrence of such an accelerating stimulus follows from the presence of "pointed" crystals of the type shown in fig. 18. That actually such crystals appear also in the recrystallized test-pieces of ANDERSON and MEHL is evident

[33]) We are inclined to think that several other phenomena, observed while studying recrystallization, for example that of "secondary recrystallization" ("exaggerated graingrowth") and the formation of twins, is closely related to this stimulating action.

[34]) In coarse-grained material a *decrease* was observed.

from fig. 21, which is taken from their paper: the small crystallite B is most probable an example of a stimulated crystal.

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