Maillard reactions – a clarification

On p 90 of Kitchen Chemistry, the statement is made that Maillard reactions do not take place at temperatures below 140 ^{o}C. This statement is not literally true and we are grateful to Jurek Mlotkiewicz of the Firmenich company for the following clarification.

The Maillard reaction is a chemical reaction between an amino acid and a reducing sugar, usually requiring heat. It is not a single reaction but is composed of a large series of interdependent reactions, generating colour and aroma chemicals.
There are a series of parameters which are important contributors to the progress/direction of the reaction sequence namely temperature and time but also pH and water activity.

Whilst heat is normally considered a prerequisite for the Maillard reaction and we associate the dark colour of the outer surfaces of roast beef and bread with this heating process, it should be noted that the reaction *can* take place at temperatures well below 140°C. One of the major reasons for the difference between the dark roasted outer and the pale bloody inner parts of roast beef is due to the link between temperature and water content. Because the internal temperature of the meat remains much lower, the water content of the meat is high and consequently the reaction kinetics are different. However the Maillard reaction still occurs by different pathways and different products are generated.

The Maillard reaction has been studied on simple reaction mixtures stored in a refrigerator at 4°C. Even at this temperature, the reaction progressed albeit slowly.

One example of the Maillard reaction at room temperature is the gradual browning of powdered milk.This is due to the interaction of the whey proteins with the lactose (which is a disaccharide and a reducing sugar). The obvious effect is the formation of brown colour in the milk but also the amino acid lysine in the protein is depleted (it is very reactive due to the presence of two amino groups in the molecule).

Within the flavour industry, Maillard chemistry is used effectively to generate flavour bases with specific tonalities which are applied in the development of flavour products utilised in the food processing industry. It is very common to find Maillard reactions being carried out within the temperature range 90-110°C.