

BREAD RATIONING*

After Germany had lost the war, the economic situation of the country rapidly deteriorated. All food was rationed, the most important item, bread, being limited to two hundred grams per person per day. Every baker was instructed to get special forms in which to bake loaves of exactly that size, one loaf daily for each customer in his district.

Dr. Karl Z., an old physics professor, stopped at the bakery each morning on his way to the university to get his daily ration. One day he said to the baker in his district,

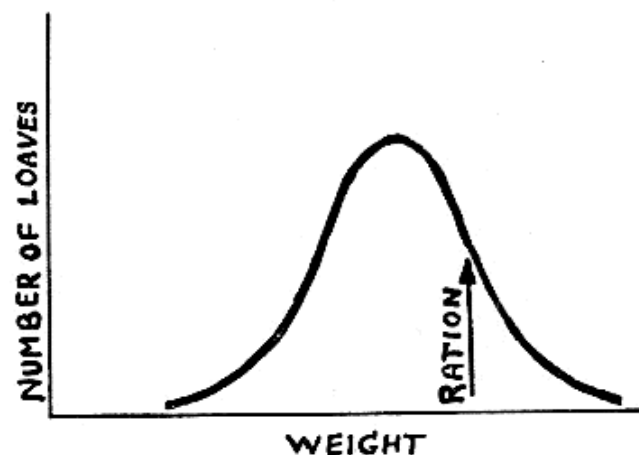


* This incident was communicated to the authors by Dr. Karl Gaede, who said that it occurred in Hamburg after World War II.

"You are a bad man and are cheating your customers. The forms you are using are five per cent smaller than they should be for baking 200-gram loaves, and the flour you save you are selling on the black market."

"But Herr Professor," exclaimed the baker, "nobody can bake loaves of bread of exactly the same size. Some will be a few per cent smaller than prescribed, some a few per cent larger."

"Exactly so," replied Professor Z. "I have been weighing the loaves you have given me for the past few months on exact scales which I happen to have in my laboratory. They show a natural variance. But here is a graph of the number of your loaves of different weight as compared to the correct weight:



"You see that, whereas some loaves weigh as little as 185 grams and others as much as 205, the *average* weight obtained in mean measurements is 195, instead of 200. You must get new forms of the correct size, or else I will report you to the authorities."

"I will certainly do it tomorrow, Herr Professor," said the scared baker, "and you may rest assured that this mistake will not be repeated."

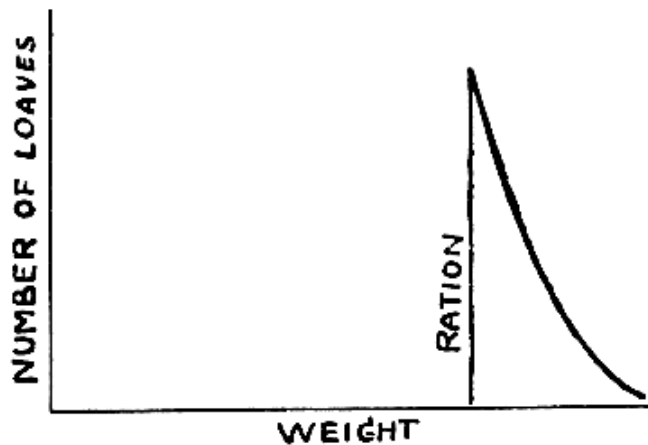
A few months later Professor Z. addressed the baker again. "I have reported you to the authorities today," he said. "You didn't change your forms and are continuing to cheat your customers."

"But Herr Professor!" exclaimed the baker. "You cannot accuse me of cheating now. Were any of the loaves I gave you during these last few months underweight?"

"No, they were all 200 grams or over. However, this did not happen because you got larger baking forms, but because you were specially selecting the larger loaves for me, giving the underweight ones to other customers."

"You cannot prove it!" said the baker arrogantly.

"Oh yes I can," declared Professor Z. "Look at the statistical distribution I got by weighing your bread for the last few months:



"Instead of the standard error distribution demonstrated by the great German mathematician, Karl Friedrich Gauss, we have here an oversized curve, sharply cut on the left side, and slowly descending on the right. Statistical deviations from the mean cannot possibly lead to such a distribution, and it is clear that it was produced artificially by selecting loaves weighing 200 grams or more. It is just the tail of Gauss's distribution, and that is the same distribution I obtained by weighing loaves before our previous conversation. I am sure the rationing authorities will take my word for it."

And turning on his heel, Professor Z. walked out of the shop.