

Macaroni Holes

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There is an NHK television show that I sometimes watch called *Bi no tsubo* [The Essence of Beauty]. One day, they took up pasta as their theme. I'm not exactly a gourmand, and so am usually not interested in cooking shows, but there was something about the sight of *conchiglie* "seashell" pasta emerging from a pasta press that kept me entranced. Folks my age are familiar with pasta like spaghetti and macaroni, but seeing it in new shapes like this make me realize that much more is possible.

You make pasta by kneading flour and water to make dough and feeding it into a pasta press, which applies high pressure to squeeze out the dough and cuts it into lengths appropriate for *conchiglie* or macaroni or what have you. The extruder that the pasta exits from is called the die, and its shape determines the form of the pasta produced. In a sense, therefore, the die is the most important part of a pasta machine.

Dies are round and have holes of varying shapes, and it is interesting to try predicting the shape of pasta that will emerge from the die holes. As you might guess, spaghetti is produced from simple round holes, with the diameter determining the thickness. Watching *conchiglie* be made is a truly interesting experience. The die hole that produces it is shaped like a bent, wavy line. Who would think that this would produce a seashell shape?

As the lump of pasta dough is pressed out of the holes, a revolving cutter slices off even-sized *conchiglie*. Even watching it being made, I couldn't imagine why the result wasn't just a long, bent noodle, so I sent an inquiry to NHK.

It turns out that it is not only the shape of the die at its exit (the front), but also the form at its entrance (the back) that is key to the shape of the pasta. There are three holes on the back of a *conchiglie* die: a large one in the middle and two smaller ones on either side. More dough is therefore passed through the middle, which forms the center of the shell, and less on the sides. This imbalance between the amounts of dough is what causes the pasta to

curl, I was told. So while there's a tendency to focus on the exit holes of a die, there are also important aspects of the die entrance and the space in-between.

Having gained a basic understanding of how *conchiglie* is formed, I next wondered how it was possible to create the holes in macaroni. A spaghetti die is easy enough to understand; you just press dough through a hole and cut it off. But it doesn't seem like it would be so easy to make hollow pasta.

I imagined dough being wrapped around a rod that is then pulled out, similar to how *chikuwa* is made in Japan. I also imagined thick spaghetti being hollowed out, but that didn't seem well suited to mass production.

Looking at an actual macaroni die solved the mystery. It is shaped like a tube from two concentric circles, with the die blocking the middle of the smaller circle and the exterior of the larger circle. Macaroni is created by squeezing pasta dough between the two. This raises the question of how the middle circle is supported to form the core around which the noodle is formed.

This is accomplished by the macaroni die having a wide entrance that narrows toward the exit. There are pins supporting the core, connecting it with the exterior circle, and these split the dough as it passes by, but it rejoins deeper into the die, past the pin. The result is a circle that is broken along the initial path through the die, but is rejoined at the exit. In mathematics, a broken circle is nothing like a complete circle, but fields like chemistry and biology are more accommodating of approximations, and a bit of pressure is all it takes to rejoin separated pasta. Learning the secrets of making macaroni went a long way towards providing a bit more flexibility to my math-hardened brain.



(a) Exit (b) Entrance

A macaroni die