Part III : Deathnium

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As the industry continued to explore ways to improve the transistor it became clear that using vacuum deposition techniques to deposit ultra-thin layers of material onto wafers provided far superior control over junction geometry and carrier longevity. Likewise, material purity improved. As a result, the end of the 1960's saw a mass migration to planar technology whereby semiconductors were constructed via epitaxial (deposition) techniques instead of alloying.

At the same time, there was a race to establish Germanium or Silicon as the semiconducting substrate of choice. Silicon won for a number of reasons but basically because the teams working on it finished first. Germanium is actually faster (for electrons to cross the junction) than Silicon, but this took second-fiddle to market readiness and no doubt other factors such as temperature stability.

Despite the miraculous discoveries of the prior decades, what happened to semiconductor fabrication in the 1960's was nothing short of a revolution. Epitaxial methods quickly led to the development of integrated circuits--multiple transistors on a single substrate--better yield, better high-frequency response and a virtual abandonment of prior techniques. The Alloy-Junction transistor went the way of the dinosaur. The rest, as they say, is history.

If you measure the junction capacitance across the Base and Collector of Alloy-Junction transistors and compare it to their modern planar/mesa/epitaxial style counterparts, the difference may appear insignificant at first—e.g. 25pF vs. 3pF. It might be hard to hear the difference between two capacitors of such small magnitude across an audio signal.

However, you will recall from the first installment that the Miller Effect says that this capacitance gets multiplied by the effective gain of the transistor. In grounded-Emitter circuits like a fuzz face, this is the Beta/Hfe value, which may or may not resemble the one published on the transistor's spec sheet.

Hence 25pf in a grounded-Emitter transistor with Hfe 150 becomes > 0.003uF--even more so in higher-gain situations. Start ganging transistors in series like a fuzz face and adding positive feedback and this capacitance starts to have audible consequences quickly. For example, the relatively low junction capacitance of modern Germanium transistors and the (planar) Silicon BC108 and BC184 transistors used in early Silicon Fuzz faces manifests itself in fuzz that is pricklier with more sizzle, among other things.

Viewed as a musical instrument, the transistor has undergone radical transformation since its invention and not all of it for the better; the needs and preferences of a guitarist do not necessarily align with those of a chip foundry. It is unlikely that industry will reverse course. Because of this, we are left with a legacy of musical devices that were developed contemporaneously with—and because of—the aggressive transistor r&d that took place in the middle of the 20th Century. As such, they offer a snapshot of how things used to be during a brief period of time.

The musical potential of the fuzz face stems not only from the shortcomings in how the circuit is engineered (that is, if we can agree that having to hand-select parts for a device is a mass-production nightmare) but also from what might likewise by today’s standards be considered imperfections in the very transistors themselves.

Progress grinds relentlessly onward, but sometimes it’s the mistakes that stick.