

this root process that I described in *New Obsidian*—adding animal custody to the obsidian trade, that is, adding new kinds of work to other kinds of older work. So before considering cities themselves we shall investigate, in this chapter, how new work is added to old.

How One Kind of Work Leads to Another

Let us begin by dissecting a few examples of innovation. Brassiere manufacturing affords an illustration. It is work that did not exist until the early 1920s, when it was developed in New York. At the time this happened, American women wore various undergarments called corset covers, chemises and ferris waists. A custom seamstress, Mrs. Ida Rosenthal, was making dresses in a small shop of her own in New York. But she was dissatisfied with the way the dresses she made hung on her customers. To improve the fit, she began experimenting with improvements to underclothing and the result was the first brassiere. The customers liked the brassieres, and it became Mrs. Rosenthal's practice to give out a custom-made brassiere with each dress she made. Brassiere making, at this point, was still only a side issue to the dressmaking, a kind of accessory activity to the older work.

But the fact was that Mrs. Rosenthal had become more interested in making brassieres than in making dresses, and while she was turning out dresses she was also making plans. She found a partner and together they raised enough capital to open and staff a workroom—a rudimentary factory—and Mrs. Rosenthal dropped dressmaking to devote herself to manufacturing, wholesaling and distributing brassieres. The new work now stood as an activity in its own right.

In this process, it does not matter who carries out the new work, as long as somebody does. It is not always the creator of the new goods or service who presides over its production. For example, a news item from the Soviet

Union describes an electronically operated artificial hand for amputees and persons with birth defects. It was devised, the press report said, by technicians in a laboratory serving the Soviet space program. Presumably they had been working on electronic controls for space vehicles. The report goes on to say that the Soviet government plans to put the hand into production by parceling out the various manufacturing operations to factories making radio components. This is often the way production of some new goods or service is carried out. The new work is added to older work first, and then sometimes its new divisions of labor are added to other appropriate varieties of older work.

Now let us look at a somewhat more complicated case in which one thing led to whole groups of other things. In this instance, the starting point was abrasive sand which was used by manufacturers of metal castings and other metal products in Minneapolis. The sand was produced by a small and obscure company founded in 1902, called Minnesota Mining and Manufacturing Co. This grandiose name merely represented two proprietors and a few workers who were engaged in digging, crushing, sorting and selling sand.

The first additional goods that this work led to was sandpaper. The proprietors decided to stick some of the sorted sand on paper for sale to carpenters, cabinet-makers and other woodworkers. They had not invented sandpaper as Mrs. Rosenthal invented brassieres or the Soviet technicians invented an electronic hand. Sandpaper was not new. But 3M, as this company now calls itself, was adding new work to older work nevertheless, while copying an already existing product.

The sandpaper turned out to be not much good. The trouble lay with the adhesives. Trying to solve their problem, the proprietors of 3M kept brewing new kinds of adhesives and got much interested in them, even though they did not lead to much improvement in the sand-

paper. What the work with adhesives led to, instead, was some good gummed paper for use as masking tape by house painters. Making masking tape led to making other kinds of tape at 3M, and thus to a whole family of additional products, some of which were true innovations. In their order of emergence, the progeny of the masking tape were: shoe tape, electrical tape, acetate tape, pressure-sensitive adhesive tape (better known as Scotch tape), acetate fiber tape, cellophane tape, printed cellophane tape, plastic tape, filament tape, sound recording magnetic tape, nonwoven synthetic fibers.

In the meantime, the proprietors of 3M had not lost interest in other possible uses for adhesives and still another family of products branched off from that work: sandblasting stencils, automotive adhesives, industrial adhesives, marine adhesives, marine caulking compounds, tile and construction adhesives, construction compounds.

The sand, from which all this had started, was not forgotten either, for in addition to abrasive sand the company proceeded to produce coated sand for polishing, then wax and varnish coatings, finely ground paint pigments, roofing granules, nonslip cleats and strips, abrasive cloth, reflective sheeting, reflective compounds, paving materials, and welding fluxes. All these were logical additions to work that began with preparing sand.

This process in which one sort of work leads to another must have happened millions of times in the whole history of human economic development. Every newspaper reports it. From only a few days' gleanings in the women's pages, one learns that a cleaner of suede clothing is now starting to bottle and sell her cleaning fluid for people who want to clean their own suede; a chest and wardrobe manufacturer is starting, for a fee, to analyze what is wrong with one's household or office storage arrangements; a playground designer is starting to make and sell equipment for playgrounds and nursery schools;