

Paperfolders Need Lots of Fiber

by James Lucas

Thomas Hull's geometric modular origami polyhedra are inspired by his career as a mathematician. As a graduate student in ethnobotany — the study of our relationship with plants — I have spent a lot of time thinking about how to transform plants into paper. And as an origami designer, I have spent a lot of time thinking about the converse: how to transform paper into (origami) plants. By bringing these transformations together, we can see that origami practitioners have a fundamental relationship with plants — through paper.

Paper, a flat material made from pulped or beaten plant fibers, is one of the most important and underappreciated plant products, as it has allowed cultures around the world to record their history and art in a readily transportable form. Traditionally made by hand, paper is more commonly and more cheaply made by machine, and countless varieties and brands of papers are now available, each with unique properties and personalities.

What explains the diversity of paper? In many cases, different paper properties are



Maris, a Significant Otter. Designed and folded by Jared Needle from one uncut square of dó paper (Photo by Jared Needle).

Geosternbergia. Designed and folded by Nguyễn Hùng Cường from one uncut duo sheet of pearl crumpled (VOG) paper. (Photo: Nguyễn Hùng Cường)



due to key modifications in the industrial papermaking process (for example, impregnating paper with paraffin to make wax paper). But paper properties also depend on the kind of fiber used; this is especially apparent among handmade papers. For example, gampi (*Wikstroemia sikokiana*), a poisonous Japanese shrub, is used to make a toxic handmade paper that insects do not eat. Paper mulberry (*Broussonetia monoica*) bears coarse, long, and strong fibers in its inner bark tissue, and early papermakers have coopted this property for making thin, crisp, durable sheets of kozo and hanji. And lokta (*Daphne bholua*), a bush from Nepal, has slightly shorter and softer fibers than paper mulberry, so paper made from it looks like fur and feels like leather. These very paper properties, originating in part from the plant's microphysiology, have enabled origamists to tailor particular papers to particular kinds of origami: thin kozo sheets can withstand the repeated sinks and pleats typical of supercomplex insect designs, while thicker, textured lokta is excellent for folding mammal designs. The diversity of modern origami draws not

Many origami practitioners find crossovers between their interests. Satoshi Kamiya's supercomplex dragon designs are inspired by characters in the *Final Fantasy* video game series he plays.

just from the diversity of origami design theory, but from the diversity of paper in the origamist's palette, and ultimately, from plant diversity itself.

How do we know this? In feudal Japan only three types of fiber were used for paper (and therefore origami): paper mulberry, gampi, and mitsumata (*Edgeworthia chrysantha*). When Akira Yoshizawa introduced modern origami from Japan to the rest of the world in the 1950s, new origamists began to experiment, folding various designs from the types of papers that were both accessible and familiar to them. Today, you may find hundreds of kinds of paper in online origami shops, each with unique characteristics suitable for specific kinds of origami. In this article, I would like to focus on one remarkable case study on paper co-optation: Vietnam.

Case study

When the Vietnam Origami Group (VOG) formed in 2005, the folding medium of choice was (and for some Vietnamese



Groot. Designed by Steve de Clercq and folded by Ryan Charpentier from one uncut rectangle of dó paper. (Photo by Ryan Charpentier)

origamists, still is) pearl crumpled paper, a crisp, thin, and sparkly giftwrapping paper made by machine in China and embossed with a scaly pattern. It became so popular among VOG that it soon became known and sold to origamists abroad as “VOG paper.” However, for origamists like Nguyễn Hùng Cường, VOG paper still fell short: it is available in only ten or twelve colors, it can be brittle if folded excessively, and it can be challenging to shape with curved folds. For the most complex arthropods, even VOG paper was too thick for folding. Handmade papers like Japanese kozo and Philippine abaca (*Musa textilis*) demonstrably had the requisite strength, thinness, and texture for folding complex designs, but they were not available in Vietnam at the time. What had not yet been tested for origami was Vietnam’s very own handmade paper: dó.

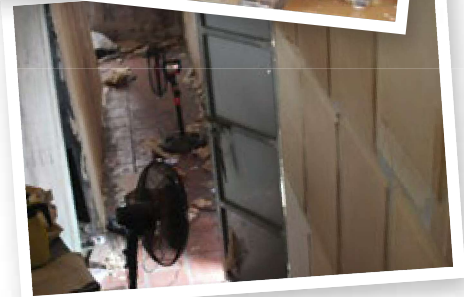
Dó (pronounced “zaw”) paper is made only by a handful of families in Dương Ổ village, just outside of Hanoi. Dó paper is made from the beaten bark of the dó tree (*Rhamnoneuron balansae*), which grows only in the wet hills of northwestern Vietnam and southeastern China. Once widely harvested



ABOVE. Leaves and flowers of the dó tree (*Rhamnoneuron balansae*). (Photo: James Lucas)

ABOVE RIGHT. A Vietnamese papermaker uses a mat and frame to make dó paper. (Photo: James Lucas)

RIGHT. Once dó sheets are formed, they are stuck to the wall and dried with electric fans.



across northern Vietnam, just three villages today still strip, dry, and bale dó bark every summer for shipment to the Dương Ổ papermakers.

Vietnam’s hand papermaking process strongly resembles that of Japan: 1) rehydrate dried bark strips, to soften them; 2) shave off the coarse outer bark; 3) cook and beat the inner bark; 4) suspend the resulting pulp in a basin of mucilaginous water; 5) form sheets using a mold and mat; and 6) stack and drain the wet sheets in a screw press. The final step, however is uniquely Vietnamese; while in most papermaking cultures paper is dried in the sun or on a heated metal sheet, in Vietnam, they 7) stick damp paper on concrete walls and dry them with an army of floor fans.

Once used extensively in votive offerings, calligraphy, and fireworks, dó paper is little made and little used today, primarily due to the cheapness and availability of machine-made wood pulp paper. However, like its relatives lokta and gampi, the dó tree has long fibers in its bark and paper made from it is extremely strong. So, in 2009, Cường began experimenting with dó for his origami designs.

Although strong and thin, dó paper is not crisp, which makes folding from it a challenge. One option to circumvent this problem is to treat the paper with a stiffening agent like methylcellulose (MC). However, MC is not readily available in Vietnam, so

Cường treats his dó paper before folding with a dilute solution of white glue—sometimes mixed with a little acrylic ink for color—using a rolling brush. Other VOG origamists followed suit; in southern Vietnam, Trần Trung Hiếu now uses the same technique for treating Thai kozo paper, which has only recently become available in-country. These experiments and co-optations by VOG members have helped not only to increase the visibility and accessibility of novel origami papers, but also to encourage future discoveries and innovations with such papers among the international origami community.

Conclusion

Most readers of this article are primarily focused on how paper is transformed into origami. My hope is that you will see that transformation in a broader ethnobotanical context, one that builds upon many ancient and intimate traditions of transforming specific plants into paper. The diversity of paper-making plants and traditions have, in turn, helped origami become a globally practiced craft and art. Now, as dó and other kinds of papermaking become moribund due to competition with industrial papermaking, it is time to acknowledge and support these traditions that have helped make origami what it is today. Many popular science articles cite origami and its applications in STEM (science, technology, engineering, and mathematics) fields, but we shouldn’t neglect its roots: papermaking, anthropology, and ethnobotany. 📖