Taste for Makers

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| "...Copernicus'
aesthetic objections to [equants] provided one essential
motive for his rejection of the Ptolemaic system...."
- Thomas Kuhn, The Copernican Revolution

"All of us had been trained by Kelly Johnson and believed
fanatically in his insistence that an airplane that looked
beautiful would fly the same way."

- Ben Rich, Skunk Works

"Beauty is the first test: there is no permanent place in this
world for ugly mathematics."

- G. H. Hardy, A Mathematician's Apology
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I was talking recently to a friend who teaches
at MIT. His field is hot now and
every year he is inundated by applications from
would-be graduate students. "A lot of them seem smart,"
he said. "What I can't tell is whether they have any kind
of taste."

Taste. You don't hear that word much now.
And yet we still need the underlying
concept, whatever we call it. What my friend meant was

that he wanted students who were not just good technicians, but who could use their technical knowledge to design beautiful things.

Mathematicians call good work "beautiful," and so, either now or in the past, have scientists, engineers, musicians, architects, designers, writers, and painters.
Is it just a coincidence that they used the same word, or is there some overlap in what they meant? If there is an overlap, can we use one field's discoveries about beauty to help us in another?

For those of us who design things, these are not just theoretical questions. If there is such a thing as beauty, we need to be able to recognize it. We need good taste to make good things.
Instead of treating beauty as an airy abstraction, to be either blathered about or avoided depending on how one feels about airy abstractions, let's try considering it as a practical question: how do you make good stuff?

If you mention taste nowadays, a lot of people will tell you that "taste is subjective."
They believe this because it really feels that way to them. When they like something, they have no idea why. It could be because it's beautiful, or because their mother had one, or because they saw a movie star with one in a magazine, or because they know it's expensive.
Their thoughts are a tangle of unexamined impulses.

Most of us are encouraged, as children, to leave this tangle unexamined. If you make fun of your little brother for coloring people green in his coloring book, your mother is likely to tell you something like "you like to do it your way and he likes to do it his way."

Your mother at this point is not trying to teach you important truths about aesthetics. She's trying to get the two of you to stop bickering.

Like many of the half-truths adults tell us, this one contradicts other things they tell us. After dinning into you that taste is merely a matter of personal preference, they take you to the museum and tell you that you should pay attention because Leonardo is a great artist.

What goes through the kid's head at this point? What does he think "great artist" means? After having been told for years that everyone just likes to do things their own way, he is unlikely to head straight for the conclusion that a great artist is someone whose work is better than the others'. A far more likely theory, in his Ptolemaic model of the universe, is that a great artist is something that's good for you, like broccoli, because someone said so in a book.

Saying that taste is just personal preference is a good way to prevent disputes. The trouble is, it's not true. You feel this when you start to design things.

Whatever job people do, they naturally want to do better. Football players like to win games. CEOs like to increase earnings. It's a matter of pride, and a real pleasure, to get better at your job. But if your job is to design things, and there is no such thing as beauty, then there is no way to get better at your job. If taste is just personal preference, then everyone's is already perfect: you like whatever you like, and that's it.

As in any job, as you continue to design things, you'll get better at it. Your tastes will change. And, like anyone who gets better at their job, you'll know you're getting better. If so,

your old tastes were
not merely different, but worse. Poof goes the axiom that
taste can't be wrong.

Relativism is fashionable at the moment, and that may hamper
you from thinking about taste, even as yours grows.
But if you come out of the closet and admit, at least to yourself,
that there is such a thing as good and bad design, then you
can start to study good design in detail.
How has
your taste changed? When you made mistakes, what
caused you to make them? What have other people learned about
design?

Once you start to examine the question, it's surprising how
much different fields' ideas of beauty have in common. The same
principles of good design crop up again and again.

Good design is simple. You hear this from math to
painting. In math it means that a shorter proof tends to be
a better one. Where axioms are concerned, especially,
less is more. It means much the same thing in programming.
For architects and designers it means that beauty should
depend on a few carefully chosen structural elements
rather than a profusion of superficial ornament. (Ornament
is not in itself bad, only when it's camouflage on insipid
form.) Similarly, in painting, a
still life of a few carefully observed and solidly
modelled objects will tend to be more interesting than a
stretch of flashy
but mindlessly repetitive painting of, say, a lace collar.
In writing it means: say what you mean
and say it briefly.

It seems strange to have to emphasize simplicity.
You'd think simple would be the default. Ornate
is more work. But something seems to come over people
when they try to be creative. Beginning writers adopt

a pompous tone that doesn't sound anything like the way
they speak. Designers trying to be artistic resort to
swooshes and curlicues. Painters discover that they're expressionists.
It's all evasion.
Underneath
the long words or the "expressive" brush strokes, there
is not much going on, and that's frightening.

When you're
forced to be simple, you're forced to face the real problem.
When you can't deliver ornament, you have to deliver
substance.

Good design is timeless.
In math, every proof is timeless unless it contains a mistake.
So what does Hardy mean when he says there is no permanent
place for ugly mathematics? He means the same thing Kelly Johnson did:
if something is ugly, it can't be the best solution. There
must be a better one, and eventually
someone will discover it.

Aiming at timelessness is a way to make
yourself find the best answer:
if you can imagine someone surpassing you, you should do it yourself.
Some of the greatest masters did this so well that they
left little room for those who came after.
Every engraver since Durer has had to live in his shadow.

Aiming at timelessness is also a way to evade
the grip of fashion. Fashions almost by definition
change with time, so if you can make something that
will still look good far into the future, then its
appeal must derive more from merit and less from fashion.

Strangely enough, if you want to make something that will
appeal to future generations, one way to do it is to
try to appeal to past generations. It's hard to guess what
the future will be like, but we can be sure it will be

like the past in caring nothing for present fashions.
So if you can make something that appeals to people today
and would also have appealed to people in 1500, there is a good
chance it will appeal to people in 2500.

Good design solves the right problem. The typical
stove has four burners arranged in a square, and a dial
to control each. How do you arrange the dials? The
simplest answer is to put them in a row. But this is a
simple answer to the wrong question.
The dials are for humans to use, and if you put them in a row,
the unlucky human will have to stop and think each time
about which dial matches which burner. Better to arrange the dials
in a square like the burners.

A lot of bad design is industrious, but misguided.
In the mid twentieth century there was a vogue for
setting text in sans-serif fonts.
These fonts are closer to the pure, underlying letterforms.
But in text that's not the problem you're trying to solve.
For legibility it's more important that letters be easy
to tell apart.
It may look Victorian, but a Times Roman lowercase g is
easy to tell from a lowercase y.

Problems can be improved as well as solutions.
In software, an intractable problem can usually be replaced
by an equivalent one that's easy to solve.
Physics progressed faster as the problem became
predicting observable behavior, instead of reconciling it
with scripture.

Good design is suggestive.
Jane Austen's novels contain almost no
description; instead of telling you how
everything looks, she tells her story so well that you

envision the scene for yourself.
Likewise, a painting that suggests is usually more engaging
than one that tells. Everyone makes up their own story about the
Mona Lisa.

In architecture and design, this
principle means that a building or object should let you
use it how you want: a good building, for example, will
serve as a backdrop for whatever life people want to lead in it, instead
of making them live as if they were executing a program
written by the architect.

In software, it means you should give users a few
basic elements that they can combine as they wish, like Lego.
In math it means a proof that
becomes the basis for a lot of new work is
preferable to a proof that was difficult,
but doesn't lead to future discoveries; in the
sciences generally, citation is considered a rough
indicator of merit.

Good design is often slightly funny. This one
may not always be true. But Durer's
engravings
and Saarinen's
womb chair and the
Pantheon and the
original Porsche 911 all seem
to me slightly funny. Godel's incompleteness theorem
seems like a practical joke.

I think it's because humor is related to strength.
To have a sense of humor is to be strong:
to keep one's sense of humor is to shrug off misfortunes,
and to lose one's sense of humor is to be wounded by them.
And so the mark-- or at least the prerogative-- of strength
is not to take
oneself too seriously.

The confident will often, like
swallows, seem to be making fun of the whole process slightly,
as Hitchcock does in his films or Bruegel in his paintings-- or
Shakespeare, for that matter.

Good design may not have to be funny, but it's hard to
imagine something that could be called humorless also being
good design.

Good design is hard. If you look at the people who've
done great work, one thing they all seem to have in common is that they
worked very hard. If you're not working hard,
you're probably wasting your time.

Hard problems call for great
efforts. In math, difficult proofs require ingenious solutions,
and those tend to be interesting. Ditto in engineering.

When you
have to climb a mountain you toss everything unnecessary
out of your pack. And so an architect who has to build
on a difficult site, or a small budget, will find that he
is forced to produce an elegant design. Fashions and
flourishes get knocked aside by the difficult business
of solving the problem at all.

Not every kind of hard is good. There is good pain and bad pain.
You want the kind of pain you get from going running, not the
kind you get from stepping on a nail.
A difficult
problem could be good for a designer, but a fickle client or unreliable
materials would not be.

In art, the highest place has traditionally been given to
paintings of people. There is something to this tradition,
and not just because pictures of faces get to press
buttons in our brains that other pictures don't. We are
so good at looking at faces that we force anyone who

draws them to work hard to satisfy us. If you
draw a tree and you change the angle of a branch
five degrees, no one will know. When you change the angle
of someone's eye five degrees, people notice.

When Bauhaus designers adopted Sullivan's "form follows function,"
what they meant was, form should follow function. And
if function is hard enough, form is forced to follow it,
because there is no effort to spare for error. Wild animals
are beautiful because they have hard lives.

Good design looks easy. Like great athletes,
great designers make it look easy. Mostly this is
an illusion. The easy, conversational tone of good
writing comes only on the eighth rewrite.

In science and engineering, some of the greatest
discoveries seem so simple that you say to yourself,
I could have thought of that. The discoverer is
entitled to reply, why didn't you?

Some Leonardo heads are just a few lines. You look
at them and you think, all you have to do is get eight
or ten lines in the right place and you've made this beautiful
portrait. Well, yes, but you have to get them in
exactly the right place. The slightest error
will make the whole thing collapse.

Line drawings are in fact the most difficult visual
medium, because they demand near perfection.
In math terms, they are a closed-form solution; lesser
artists literally solve the same problems by successive
approximation. One of the reasons kids give up drawing
at ten or so is that they decide to start
drawing like grownups, and one of the first things
they try is a line drawing of a face. Smack!

In most fields the appearance of ease seems to come with

practice. Perhaps what practice does is train your
unconscious mind to handle tasks that used to
require conscious thought. In some cases
you literally train your body. An expert pianist can
play notes faster than the brain can send signals to
his hand.
Likewise an artist, after a while, can
make visual perception flow in through his eye and
out through his hand as automatically as someone tapping his foot to
a beat.

When people talk about being in
"the zone," I think what they mean is that the
spinal cord has the situation under control.
Your spinal cord is less hesitant, and
it frees conscious thought for the hard problems.

Good design uses symmetry.
I think symmetry may just
be one way to achieve simplicity, but it's important enough
to be mentioned on its own.
Nature uses it a lot, which is a good sign.

There are two kinds of symmetry, repetition and recursion.
Recursion means repetition in subelements, like the
pattern of veins in a leaf.

Symmetry is unfashionable in some fields now, in reaction to
excesses in the past. Architects started consciously
making buildings asymmetric in Victorian times and by the
1920s asymmetry was an explicit premise of modernist architecture.
Even these buildings only tended to be asymmetric
about major axes, though; there were hundreds of minor symmetries.

In writing you find symmetry at every level, from the phrases
in a sentence to the plot of a novel. You find the same
in music and art.
Mosaics (and some Cezannes) get extra visual punch by making

the whole picture out of the same atoms. Compositional symmetry yields some of the most memorable paintings, especially when two halves react to one another, as in the Creation of Adam or American Gothic.

In math and engineering, recursion, especially, is a big win. Inductive proofs are wonderfully short. In software, a problem that can be solved by recursion is nearly always best solved that way. The Eiffel Tower looks striking partly because it is a recursive solution, a tower on a tower.

The danger of symmetry, and repetition especially, is that it can be used as a substitute for thought.

Good design resembles nature. It's not so much that resembling nature is intrinsically good as that nature has had a long time to work on the problem. It's a good sign when your answer resembles nature's.

It's not cheating to copy.
Few would deny that a story should be like life.
Working from life is a valuable tool in painting too, though its role has often been misunderstood.
The aim is not simply to make a record.
The point of painting from life is that it gives your mind something to chew on: when your eyes are looking at something, your hand will do more interesting work.

Imitating nature also works in engineering. Boats have long had spines and ribs like an animal's ribcage.
In some cases we may have to wait for better technology: early aircraft designers were mistaken to design aircraft that looked like birds, because they didn't have materials or power sources light enough (the Wrights' engine weighed 152 lbs. and generated only 12 hp.) or control systems sophisticated

enough for machines that flew like birds, but I could
imagine little unmanned reconnaissance planes flying
like birds in fifty years.

Now that we have enough computer power, we can imitate nature's
method as well as its results. Genetic algorithms may let us
create things too complex to design in the ordinary
sense.

Good design is redesign. It's rare to get things right
the first time. Experts expect to throw away some early work.
They plan for plans to change.

It takes confidence to throw work away. You have to be able
to think, there's more where that came from.
When people first start drawing, for example,
they're often reluctant to redo parts that aren't
right; they feel they've been lucky to get that far,
and if they try to redo something, it will turn out worse. Instead
they convince themselves that the drawing is not that bad,
really-- in fact, maybe they meant it to look that way.

Dangerous territory, that; if anything you should
cultivate dissatisfaction.
In Leonardo's drawings there are often five
or six attempts to get a line right.
The distinctive back of the Porsche
911 only appeared in the redesign of an awkward
prototype.
In Wright's early plans for the
Guggenheim,
the right half was a ziggurat; he inverted it to get the
present shape.

Mistakes are natural. Instead of treating them
as disasters, make them easy to acknowledge and easy to fix.
Leonardo more or less invented the sketch, as a
way to make drawing bear a greater weight of exploration.

Open-source software has fewer bugs because it admits the possibility of bugs.

It helps to have a medium that makes change easy. When oil paint replaced tempera in the fifteenth century, it helped painters to deal with difficult subjects like the human figure because, unlike tempera, oil can be blended and overpainted.

Good design can copy. Attitudes to copying often make a round trip. A novice imitates without knowing it; next he tries consciously to be original; finally, he decides it's more important to be right than original.

Unknowing imitation is almost a recipe for bad design. If you don't know where your ideas are coming from, you're probably imitating an imitator. Raphael so pervaded mid-nineteenth century taste that almost anyone who tried to draw was imitating him, often at several removes. It was this, more than Raphael's own work, that bothered the Pre-Raphaelites.

The ambitious are not content to imitate. The second phase in the growth of taste is a conscious attempt at originality.

I think the greatest masters go on to achieve a kind of selflessness. They just want to get the right answer, and if part of the right answer has already been discovered by someone else, that's no reason not to use it. They're confident enough to take from anyone without feeling that their own vision will be lost in the process.

Good design is often strange. Some of the very best work
has an uncanny quality: Euler's
Formula,
Bruegel's
Hunters in the Snow, the
SR-71, Lisp. They're not just
beautiful, but strangely beautiful.

I'm not sure why. It may just be my own stupidity. A
can-opener must seem miraculous to a dog. Maybe if I were smart
enough it would seem the most natural thing in the world that
ei*pi = -1. It is after all necessarily true.

Most of the qualities I've mentioned are things that can be
cultivated, but I don't think it works to cultivate strangeness.
The best you can do is not squash it if it starts to appear.
Einstein didn't try to make relativity strange.
He tried to make it true, and the truth turned out to be strange.

At an art school where I once studied, the students wanted
most of all to develop a personal style.
But if you just try to make good things, you'll
inevitably do it in a distinctive way, just as each person
walks in a distinctive way. Michelangelo was not trying
to paint like Michelangelo. He was just trying to paint
well; he couldn't help painting like Michelangelo.

The only style worth having is the one you can't help.
And this is especially true for strangeness. There is no
shortcut to it. The Northwest Passage that the Mannerists,
the Romantics, and two generations of American high school
students have searched for does not seem to exist. The
only way to get there is to go through good and come out
the other side.

Good design happens in chunks. The inhabitants
of fifteenth century Florence included Brunelleschi, Ghiberti,
Donatello, Masaccio, Filippo Lippi,

Fra Angelico, Verrocchio, Botticelli, Leonardo, and Michelangelo.
Milan at the time was as big as Florence.
How many fifteenth century Milanese artists can you name?

Something was happening in Florence in the fifteenth century.
And it can't have been heredity, because it isn't happening now.
You have to assume that whatever
inborn ability Leonardo and Michelangelo had, there were
people born in Milan with just as much. What happened to
the Milanese Leonardo?

There are roughly a thousand times
as many people alive in the US right now as lived in
Florence during the fifteenth century. A thousand Leonardos
and a thousand Michelangelos walk among us.
If DNA ruled, we should be greeted daily by artistic
marvels. We aren't, and the reason is that to make Leonardo
you need more than his innate ability. You also need Florence
in 1450.

Nothing is more powerful
than a community of talented people working on related
problems. Genes count for little by comparison: being a genetic
Leonardo was not enough to compensate for having been born
near Milan instead of Florence.
Today we move around more, but great work still comes
disproportionately from a few hotspots:
the Bauhaus, the Manhattan Project, the New Yorker,
Lockheed's Skunk Works, Xerox Parc.

At any given time there are a
few hot topics and a few groups doing great work on them,
and it's nearly impossible to do
good work yourself if you're too far removed from one
of these centers. You can push or pull these trends
to some extent, but you can't break away from them.
(Maybe you can, but the Milanese Leonardo couldn't.)

Good design is often daring. At every period of history, people have believed things that were just ridiculous, and believed them so strongly that you risked ostracism or even violence by saying otherwise.

If our own time were any different, that would be remarkable. As far as I can tell it isn't.

This problem afflicts not just every era, but in some degree every field.
Much Renaissance art was in its time considered shockingly secular: according to Vasari, Botticelli repented and gave up painting, and Fra Bartolommeo and Lorenzo di Credi actually burned some of their work.
Einstein's theory of relativity offended many contemporary physicists, and was not fully accepted for decades-- in France, not until the 1950s.

Today's experimental error is tomorrow's new theory. If you want to discover great new things, then instead of turning a blind eye to the places where conventional wisdom and truth don't quite meet, you should pay particular attention to them.

As a practical matter, I think it's easier to see ugliness than to imagine beauty. Most of the people who've made beautiful things seem to have done it by fixing something that they thought ugly. Great work usually seems to happen because someone sees something and thinks, I could do better than that. Giotto saw traditional Byzantine madonnas painted according to a formula that had satisfied everyone for centuries, and to him they looked wooden and unnatural.
Copernicus was so troubled by a hack that all his contemporaries could tolerate that he felt there must be a better solution.

Intolerance for ugliness is not in itself enough. You have to understand a field well before you develop a good nose for what needs fixing. You have to do your homework. But as

you become expert in a field, you'll start to hear little voices saying, What a hack! There must be a better way. Don't ignore those voices. Cultivate them. The recipe for great work is: very exacting taste, plus the ability to gratify it.

Notes

Sullivan actually said "form ever follows function," but I think the usual misquotation is closer to what modernist architects meant.

Stephen G. Brush, "Why was Relativity Accepted?" Phys. Perspect. 1 (1999) 184-214.

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