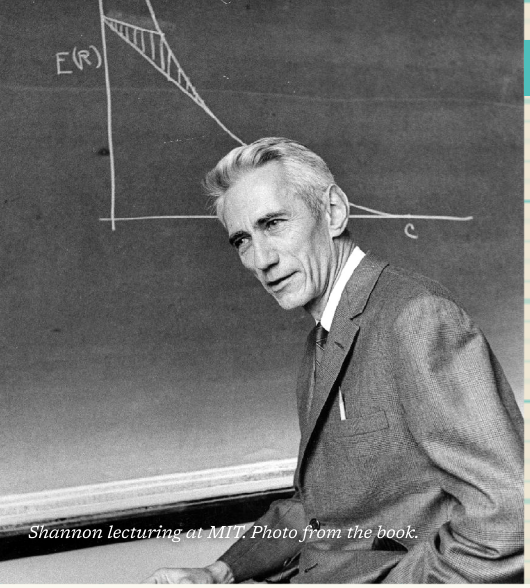
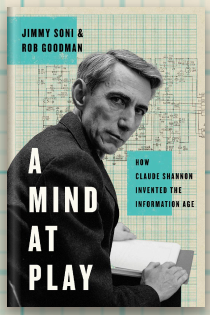


*Shannon lecturing at MIT. Photo from the book.*

CLAUDE SHANNON ON CREATIVE THINKING

# CONSTRUCTIVE DISSATISFACTION




## A MIND AT PLAY

HOW CLAUDE SHANNON INVENTED THE INFORMATION AGE · JIMMY SONI & ROB GOODMAN, 2017

*"a slight irritation when things don't look quite right"*

SHANNON DEFINING "CONSTRUCTIVE DISSATISFACTION" · BELL LABS TALK, MARCH 20, 1952

## THE TALK

Shannon left almost no memoir. The authors call this Bell Labs talk on "Creative Thinking" *"the closest he ever came to autobiography"*: a *"tantalizingly brief tutorial"* on how his mind worked. He opened bluntly:

SHANNON *"A very small percentage of the population produces the greatest proportion of the important ideas"*. Some people, given one idea, *"you will get a half an idea out"*; others produce two for each one sent in. *"Those are the people beyond the knee of the curve."*

He meant history's Newtons and Einsteins, he added, not himself, though the authors suspect *"his humility only extended so far."*

## FIVE INGREDIENTS

TALENT · TRAINING · CURIOSITY · IRRITATION · JOY

MOTIVATION *"some kind of desire to find out the answer, the desire to find out what makes things tick."* Without it *"you may have all the training and intelligence in the world, [but] you don't have the questions"*.

IRRITATION Not the depressive kind: *"constructive dissatisfaction"*. The authors' gloss: *"a genius is simply someone who is usefully irritated."*

JOY *"I get a big bang out of proving a theorem."* And the *"pleasure in seeing net results."*

## SIX STRATEGIES, IN HIS ORDER

· *he drew P's for "problems" and S's for "solutions" on the chalkboard*

### 1 SIMPLIFY

SHANNON *"if you can bring this problem down into the main issues, you can see more clearly what you're trying to do."*

AUTHORS Cut everything except what makes the problem interesting.

### 2 SIMILAR KNOWN PROBLEMS

Surround your problem with existing answers to similar questions and see what they share.

SHANNON *"It seems to be much easier to make two small jumps than the one big jump in any kind of mental thinking."*

### 3 RESTATE IT

SHANNON *"Change the words. Change the viewpoint."* Avoid *"ruts of mental thinking."*

That is why *"someone who is quite green to a problem"* sometimes solves it first.

### 4 STRUCTURAL ANALYSIS

AUTHORS Break an overwhelming problem into small pieces.

SHANNON *"Many proofs in mathematics have been actually found by extremely roundabout processes"*.

### 5 INVERT IT

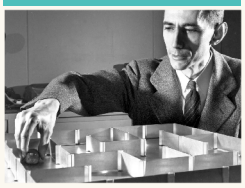
AUTHORS If you can't get from premises to conclusion, imagine the conclusion is already true and try proving the premises instead.

### 6 GENERALIZE

Once you have a solution, see how far it stretches.

SHANNON *"Someone always will come along and start generalizing it."* AUTHORS *"So why not do it yourself?"*

## HOW HE WORKED





- **Curiosity first.** *"I do what comes naturally, and usefulness is not my main goal."*
- **Build it.** Could a robot mouse learn a maze? *"Build one and find out." "What other people called hobbies, he thought of as experiments"*.
- **Several problems at once:** *"strangely enough it seems a more productive method than sticking to one problem."*
- **Picture it first.** *"I think I'm more visual than symbolic. I try to get a feeling of what's going on. Equations come later."*

## HIS LIFE

| | |
|---|---|
| 1916 | Born; grows up in Gaylord, Michigan. |
| 1937 | MIT master's thesis maps Boolean logic onto switching circuits, at 21. |
| 1948 | "A Mathematical Theory of Communication": the bit, entropy, channel capacity. |
| 1949 | Marries Betty, his sounding board and editor. |
| 1950s | Theseus the maze mouse, chess machines; MIT from 1957. |
| 1985 | First Kyoto Prize in Basic Science. |
| 2001 | Dies February 24, after years of Alzheimer's. |

## USE IT MONDAY

- When something nags you, treat it as a lead, not a mood.
- Stuck? Run the six moves in order, from simplify to generalize.
- Strip the problem to its simplest case, solve it, then add the details back.
- Hand a stale problem to someone new to it.

## THE FINE PRINT

Shannon thought good researchers use these moves *"unconsciously"*; he hoped naming them would help. The authors ask why, if it were that simple, so few people produce most of the ideas. The talk's date comes from the book's notes.

*"He worked with levity and played with gravity; he never acknowledged a distinction between the two."* A MIND AT PLAY