F&SF's science editor—fellow named Asimov—had just finished an article on holography for Smithsonian Magazine and was explaining the subject to us at lunch the other day. "It's like magic," he said enthusiastically, and we nodded sagely and drifted back to the office. Where, lo and behold, the first story on our desk turned out to be about holography. Dr. Tushnet had apparently been similarly intrigued by the subject, and he's turned it into a story which is darned good fun.

A Practical Invention

by LEONARD TUSHNET

I'M A PRACTICAL MAN, which is something my sons (let them live and be well!) aren't, in spite of their brains. Brains they've got. If they weren't twins and all their brains were in one head, that head would know more than all the scientists in all the world put together. But as it is, they're very smart boys, brilliant engineers, highly regarded where they work in top jobs for a big photographic film company. I don't mention the name because the boys wouldn't like it. I know how they feel. I should know. I raised them myself, which wasn't easy with their mother dying when they were eight years old and I never remarried and trying to run a business and supervise housekeepers at the same time. But the boys were always good, God bless them!

Larry has this hobby of his with lasers. That's a way of projecting light. I don't know the details of how it works because I didn't have their advantages and didn't go to college. And Leo's an amateur magician. Very good at it, too, I must say. The boys collaborate a lot in making very ingenious tricks and illusions. The basement is filled with their equipment. That's what this is about.

Larry set up an apparatus to make an optical illusion for Leo. You know, like you see something that isn't there. It's

all done with mirrors. Larry used lasers and made what he called holograms, which are like pictures, only they're not. The negative looks like a mixed up bunch of dots and squiggles, but when you project it on a screen, it looks like you could walk around it. Three-dimensional. You wouldn't believe it if you didn't see it. An ordinary picture is flat, a picture, and it looks the same from every angle, but a hologram picture looks like the real thing, and if you go to the right or the left, you get a different view than from in front.

So—like I said, Larry made Leo a hologram illusion. He projected the picture in plain air, not on a screen. With mirrors. They showed it to me. Unbelievable! A real box floating in air, a bowl of fruit, a vase full of flowers, anything at all. Even a pile of pennies. The pennies gave me the idea.

"They're so real looking," I said, "it's a shame you can't preserve that illusion permanently. Like spraying it with clear plastic, the same as you preserve flowers." I meant like the novelties you see in stores, the dimes or the Kennedy half dollars in clear cubes like in glass.

The boys laughed. "Dad," they said together—they always spoke together—"that's only an illusion. It's not really there."

"Real. What's real? I can see it, you can see it," I answered. "We could be witnesses in court and swear to it that we saw a pile of pennies floating in thin air. Seeing's believing, right?" Then, for a joke—not entirely, because a hobby's a hobby, and fun's fun, but when you see a chance to make a buck, why not?—I said, "You boys are so smart, why don't you think up some way to keep that illusion going even when the laser's turned off? Even with pennies you'd have a lot of money "

Well, they started to explain to me about light waves not having any mass and a lot of other things I couldn't make head or tail of, but one thing I seized on. "It seems to me that if light waves, which are intangible, like you say, make something look like it's there, then all you have to do to make it really there is to coat it with something, maybe more light waves of a different kind to protect it from something that might disturb the picture. And if what isn't there could be coated like that, then it must be there, right?"

They both laughed, but I could see they were impressed with my reasoning. "Dad, you should have been a philosopher," Leo said. "You'd have beaten Bishop Berkeley at his own game." (Later I looked up the bishop in the encyclopedia.

He was a smart man, all right, and those fellows who tried to show he was wrong had a hard time of it.)

Then they started to argue with each other about the necessity for the coating to be of a specific wavelength and other stuff which was out of my field, so I left them.

A few weeks later the boys invited me to see what they'd done. To the original equipment they'd added a Rube Goldberg apparatus that they used to make a fog around the hologram picture of the object, in this case a quarter, as soon as it appeared. They switched something and the fog cleared and, believe it or not, that picture of the quarter began to drift towards the floor, very slowly, it's true, but drift it did.

"See, Dad?" Leo said. "The hologram has weight!"

"Very interesting," I said, not knowing what else to say. The picture of the quarter all of a sudden disappeared and a glob of plastic-like model airplane glue fell on the floor. "So now what?" I asked. "What did you accomplish?"

"We've solved one problem only to get into another," the boys said simultaneously. "We have to find a way to harden the coating before the hologram falls away. If we could do that, we'd have a casting of the original."

I'm a practical man, like I said. I told them, "So as soon as the fog clears and the picture begins to drop, let it fall into a liquid plastic that'll harden in less than a second. That would be a good trick, to be able to hold in your hand a casting of an optical illusion."

Well, that started them off again about how the hologram only exists in the beam of light and so forth, and then they both suddenly slowed down and looked at each other and nodded. I could see they'd thought of something.

Every once in a while after that I'd ask them how the new illusion was working out, and they kept putting me off. About six months later, when I'd almost forgotten about the whole thing, they invited me to see their working model.

In one corner of the basement were a couple of barrels. While I was putting on the goggles they made me wear, I peeked into the barrels. They looked like they were filled with coins, with quarters.

Their apparatus was different from the first time. They had a crystal-clear glass tube shaped like an X. The tube was closed except at the crosspiece of the X. There it was open at the bottom. Under it was an old mattress with what looked like lots of cigarette burns on it. Leo projected the hologram of

the quarter in one side of the tube and moved it up until it was in the exact center of the X. From the other side of the room Larry activated a different piece of apparatus, and there was a picture of a fog in the other part of the tube in a long thin band. Larry adjusted his equipment, and the picture of the fog began to move slowly until it met the hologram of the quarter in the center. "Now!" Leo said. Then they both did something, and it was like a strobe light at the center of the X. At the same time the mattress on the floor began to move back and forth and sideways. I couldn't believe my eyes. Quarters began to fall from the open part of the tube onto the mattress in nice even rows. When the mattress was covered with quarters, they stopped.

The boys laughed at my open mouth. "Pick them up, Dad," Leo said. I did. They were quarters all right, but covered with a very thin clear hard film, and very light. Not bright, but light in weight, almost like nothing.

"You gave us the idea, Dad," Larry said, "but we improved on it. You can't coat a collection of light waves with anything material, but we figured out that we should take a holographic picture of an aerosol suspension of a rapidly hardening clear plastic resin and superimpose it on the hologram of the quarter." He explained that light was not only a wave but a particle, so theoretically a coating should take place. He told me the process in detail, which I didn't pretend to understand. "And there you are! Project the negative of one on the negative of the other, and you get a positive. It's not just mathematically so, it's really philosophical. The negation of the negation, Hegel would say, but the new positive is on a higher plane than the original. It's the dialectic spiral," and more high-class talk like that.

I looked at the new quarters. Except for the shining film they were regular quarters. "And what will you use them for?" I asked.

The boys looked at each other. "We hadn't thought of using them for anything," they said. "It was just an interesting problem to solve." They must have seen the funny expression on my face, because in a flash both of them said, "We could use them for souvenirs, Dad, at the end of a performance." They both smiled, looking for my approval for being so practical.

That gives you an idea of how practical my sons are. They invent such a duplicating device, and all they can think of

for it is for amateur magic tricks!

I shook my head. "No. I have a better idea. Since these cost almost nothing, just the price of the film and the electricity, you can make a lot of things out of them." They knew what I meant, costume jewelry being my line. "Like Indian style bangles or Gypsy earrings."

"Can't be done, Dad," they said. Larry said, "Watch this." He picked up a quarter and threw it at the wall. There was like the briefest flash of rainbow color, and iridescence, and then nothing, nothing at all. The quarter was gone. "See?" Leo asked. "Once the structure is broken, you're back with light waves traveling at 186,000 miles a second."

He was right. I took up a small drill from the workbench and tried to drill a hole in a quarter. Poof! No quarter, not even a plastic film. Larry said, "They're good only for souvenirs, Dad. A giveaway novelty."

Impractical, both of them. "So make them heavier, now that they're here. Put them in a thin layer of Lucite. There's always a market for things like that—foreign coins, a little flower, even a fly."

Well, that they tried and it didn't work. The coins materialized all right, but as soon as the warm plastic hit the surface, they disappeared. The boys showed me.

If I had their education, I'd be a millionaire, I said to myself. The simplest things they can't figure out. "So, boys, in your original negative, before you take the picture, just weld on a tiny circle of metal at the top of the coin. Then you can thread silk or wire or anything through the hole." I could tell they were sore at themselves for not thinking of that. I wanted to encourage them. It's not nice for a father to put down his sons. So I said, "Look, boys, I'll tell you what I'll do. I'll get a twenty-dollar gold piece and have a jeweler attach a small circle, like I said, at the top. You make me enough duplicates and I'll put Tony (that's my designer) to work and he'll come up with ideas. And I'll split the profits with you."

That's what we did. I got a barrel full of twenty-dollar gold pieces (the solidified images, of course). They weighed almost nothing. Tony made up necklaces, chokers, earrings, headbands, and I sold them as fast as my help could put them together. I sold them to big stores in New York City and Dallas, Texas, and to fancy boutiques on Madison Avenue and on Wilshire Boulevard in Los Angeles. They were a hit.

They looked like the real thing, and after all they were the real thing in a way, but gold jewelry like that would have weighed a ton around the neck or on the arms. These were light as a feather. It was a great fad for a while, and we made a lot of money.

Why not? Electricity's cheap, the laser apparatus and the holographic equipment was already set up, and a twenty-dollar gold piece cost only seventy-two dollars in the coin store. You can see what a fantastic markup there was. We made a lot of money, like I said.

But a fad's a fad, and after the society ladies gave it up and the bargain market was saturated, I had the boys use the apparatus for something else.

I made an investment. I bought an eight-carat rose-cut flawless white diamond and had it mounted in a platinum setting like an open network. That allowed for greater freedom in designing, you see. With a barrel full of them, I really had something. The sparkle wasn't quite as good as the original because of the film, but it was still plenty, believe you me. One barrel full, that's all I made, so I could keep it as a luxury item. I had enough for tiaras, pendants, chandelier earrings, and a special job—a dress embroidered with them for the wife of an oil tycoon for her daughter's wedding. Of course, I didn't say they were diamonds, no more than I said the gold pieces were gold. They were costume jewelry, but costume jewelry of a special type. My firm got a reputation like it was Tiffany's. Our line was the leader in the industry, even for Austrian crystal and marcasite, where there's lots of competition.

There was no limit, I figured, to what we could do with solid holograms of all kinds. I told the boys we should stop until they'd patented the process. They agreed. Nice kids, but up in the air. They were getting bored. Making a fortune wasn't enough for them.

I was busy with the Christmas sales, so it was after the new year before I asked them about the patent. They looked at each other and then at me. They sighed simultaneously. "We're not patenting it, Dad."

Aha! I thought. Altruists. They'll publish in some scientific journal and give the process to humanity, and then some guy wiser than them will come along and make a little improvement, and then he'd get the patent. "Why not?" I asked, patient-like.

"It's too dangerous," they said together. Leo started with the conservation of energy and

Larry with the atom bomb, and they both talked so fast my head ached with their E equals MC squared and the reverberating effects of super-imposed waves in a harmonic series.

I stopped them. "Never mind the science. Tell me in plain English."

Leo said, "There's no easy way to explain it." Larry said, "We'll show you."

We'd just had a heavy snow, and the plows had made a big pile in the street. Larry went down to the basement and came up with a bag of quarters out of one of the barrels they'd had left over, also a BB gun. He took a quarter and put it on top of a snow pile. He put another on top of it. He took a little stone and dropped it on the coins. There was the usual iridescence when the stone hit the coins and they disappeared.

"So what?" I asked. "We know the stuff's very fragile. I don't sell it under false pretenses that it'll last."

"Look, Dad," Leo said. He showed me the space where the quarters had been. The snow was gone for about two inches around and two-three inches deep. I didn't know what he was driving at.

The boys took me around to the back of the house. We have a sloping roof, and at one point on the north side the snow slides off there and makes a pile that seems to last all winter. It was pretty big now. Leo took ten quarters and put one on top of another, gently pressing them in the snow facing us. He made us all go back to the hedge about six feet away, and he shot the BB gun at the top quarter. There was like a blizzard for a moment, and when all was clear again, that big pile of snow was gone and a smell like after an electric storm was in the air.

I got excited. I grabbed Leo's arm and hollered, "The greatest invention of all! Who needs costume jewelry? Just think! You could clear every road and highway in an hour!"

The boys shook their heads. "No, Dad. You're a peaceful man and you've raised us to be peaceful, too. Don't you see what could happen?" Leo talked, Larry talked, and I kept quiet. "This could become a weapon of destruction even more dangerous than the hydrogen bomb. Ten quarters do this. Imagine what would happen if somebody took thirty and detonated them by breaking them! With nothing more than a BB gun! Or fifty? Or a hundred? One broken replica just disappears, returning to the general photoelectromagnetic field, with physical effects too small to be measured. Two caused a disturbance, you saw, giving off heat. Ten caused a

greater disturbance and more heat plus ionization of the oxygen in the atmosphere. That's what you smelled—the ozone. We've figured out the equations up to a hundred. We were afraid to go any higher. With each tenfold increase, in addition to the explosive effects and the heat, the secondary side effects become more intensive and extensive."

We went back into the house and sat for half an hour without saying a word. I was thinking. The boys were absolutely right. Trouble enough there's in the world without us adding to it. I told them that I agreed with them. They both jumped up and kissed me, grown men and they kissed their father. Leo's eyes were like electric lights and Larry's face shown like the golden sun. "Oh, Dad, you're the greatest!" and then they quieted down, like they were sorry for me, seeing my dreams of a fortune fly away in the wind.

"Don't worry, boys," I told them. "I got enough I got you. I'll never have to worry about my old age." And we all started to cry—from happiness, not from sadness.

No patent, of course. And the apparatus was dismantled. We never talk about the invention except when there's a heavy snow. Then they just smile and I smile back when the neighbors are envious of my clear walks and driveway and they never see me shoveling. We figured out two quarters wasn't enough and ten was too much but three would be just about right for more than five inches of snowfall. I put the quarters down at regular intervals. I learned to shoot the BB gun pretty good. What's the use of an invention if nothing comes of it, I ask you? You got to be practical.

Coming next month

Featured next month will be a new story by Harlan Ellison, "Basilisk." It is about patriotism and war, but it goes far beyond the "war is hell" or "war is unhealthy for children and other living things" sort of thing. It is a strong and moving and inventive story, and you will not want to miss it.

Also featured, of course, will be the conclusion to Jack Vance's novel, plus other goodies too numerous and unplanned to mention. The August issue is on sale June 29. If you want your copy earlier, send us the coupon on page 142.