How to Fix a Motorcycle

Zen and the Art of Motorcycle Maintenance, by Robert Pirsig, is an unusual work of fiction inspired by real life events. The story follows a father and son on a motorcycle trip across the United States. During their travels, we hear the narrator's internal dialog as he considers a question of great importance to him: *what is quality*? Like Plato's *Dialogues*, the following is a work of philosophy, but what I love about it is that the author presents his thesis in the form of a discourse on motorcycle maintenance.

You are reading this excerpt because it is relevant—and in my opinion, of primary importance—to the technical work of programming a computer. Note that I have omitted some passages to make the reading shorter, and because the author intersperses the text with comments about what he is seeing and doing *as he rides his motorcycle*.

Note that Pirsig uses the term "Chautauqua" throughout the text. A *Chautauqua* is a form of storytelling education that was popular in the early 20th century in the US. You can just mentally substitute the word "dialogue" instead. [—ed.]

I like the word "gumption" because it's so homely and so forlorn and so out of style it looks as if it needs a friend and isn't likely to reject anyone who comes along. It's an old Scottish word, once used a lot by pioneers, but which, like "kin," seems to have all but dropped out of use. I like it also because it describes exactly what happens to someone who connects with quality. He gets filled with gumption.

The Greeks called it *enthousiasmos*, the root of "enthusiasm." which means literally "filled with theos," or God, or quality. See how that fits?

A person filled with gumption doesn't sit around dissipating and stewing about things. He's at the front of the train of his own awareness, watching to see what's up the track and meeting it when it comes. That's gumption.

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The gumption-filling process occurs when one is quiet long enough to see and hear and feel the real universe, not just one's own stale opinions about it. But it's nothing exotic. That's why I like the word.

You see it often in people who return from long, quiet fishing trips. Often they're a little defensive about having put so much time to "no account" because there's no intellectual justification for what they've been doing. But the returned fisherman usually has a peculiar abundance of gumption, usually for the very same things he was sick to death of a few weeks before. He hasn't been wasting time. It's only our limited cultural viewpoint that makes it seem so.

If you're going to repair a motorcycle, an adequate supply of gumption is the first and most important tool.

If you haven't got that you might as well gather up all the other tools and put them away, because they won't do you any good.

Gumption is the psychic gasoline that keeps the whole thing going. If you haven't got it there's no way the motorcycle can possibly be fixed. But if you have got it and know how to keep it there's absolutely no way in this whole world that motorcycle can keep from getting fixed. It's bound to happen. Therefore the thing that must be monitored at all times and preserved before anything else is the gumption.

This paramount importance of gumption solves a problem of format of this Chautauqua. The problem has been how to get off the generalities. If the Chautauqua gets into the actual details of fixing one individual machine the chances are overwhelming that it won't be your make and model and the information will be not only useless but dangerous, since information that fixes one model can sometimes wreck another. For detailed information of an objective sort, a separate shop manual for the specific make and model of machine must be used. In addition, a general shop manual such as *Audel's Automotive Guide* fills in the gaps.

But there's another kind of detail that no shop manual goes into but that is common to all machines and can be given here. This is the detail of the quality relationship, the gumption relationship, between the machine and the mechanic, which is just as intricate as the machine itself. Throughout the process of fixing the machine things always come up, low-quality things, from a dusted knuckle to an accidentally ruined "irreplaceable" assembly. These drain off gumption, destroy enthusiasm and leave you so discouraged you want to forget the whole business. I call these things "gumption traps."

There are hundreds of different kinds of gumption traps, maybe thousands, maybe millions. I have no way of knowing how many I don't know. I know it seems as though I've stumbled into every kind of gumption trap imaginable. What keeps me from thinking I've hit them all is that with every job I discover more. Motorcycle maintenance gets frustrating. Angering. Infuriating. That's what makes it interesting.

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What I have in mind now is a catalog of "Gumption Traps I Have Known." I want to start a whole new academic field, gumptionology, in which these traps are sorted, classified, structured into hierarchies and interrelated for the edification of future generations and the benefit of all mankind.

`Gumptionology 101 ... An examination of affective, cognitive and psychomotor blocks in the perception of quality relationships ... 3 cr, VII, MWF.` I'd like to see that in a college catalog somewhere.

In traditional maintenance gumption is considered something you're born with or have acquired as a result of good upbringing. It's a fixed commodity. From the lack of information about how one acquires this gumption one might assume that a person without any gumption is a hopeless case.

In nondualistic maintenance gumption isn't a fixed commodity. It's variable, a reservoir of good spirits that can be added to or subtracted from. Since it's a result of the perception of quality, a gumption trap, consequently, can be defined as anything that causes one to lose sight of quality, and thus lose one's enthusiasm for what one is doing. As one might guess from a definition as broad as this, the field is enormous and only a beginning sketch can be attempted here.

As far as I can see there are two main types of gumption traps. The first type is those in which you're thrown off the quality track by conditions that arise from external circumstances, and I call these "setbacks." The second type is traps in which you're thrown off the quality track by conditions that are primarily within yourself. These I don't have any generic name for . . . "hang-ups" I suppose. I'll take up the externally caused

setbacks first.

The first time you do any major job it seems as though the out-of-sequence-reassembly setback is your biggest worry. This occurs usually at a time when you think you're almost done. After days of work you finally have it all together except for: What's this? A connecting-rod bearing liner?! How could you have left that out? Oh Jesus, everything's got to come apart again! You can almost hear the gumption escaping. Psssssssssssss.

There's nothing you can do but go back and take it all apart again—after a rest period of up to a month that allows you to get used to the idea.

There are two techniques I use to prevent the out-of-sequence-reassembly setback. I use them mainly when I'm getting into a complex assembly I don't know anything about.

It should be inserted here parenthetically that there's a school of mechanical thought which says I shouldn't be getting into a complex assembly I don't know anything about. I should have training or leave the job to a specialist. That's a self-serving school of mechanical eliteness I'd like to see wiped out. That was a "specialist" who broke [. . .] this machine. I've edited manuals written to train specialists for IBM, and what they know when they're done isn't that great. You're at a disadvantage the first time around and it may cost you a little more because of parts you accidentally damage, and it will almost undoubtedly take a lot more time, but the next time around you're way ahead of the specialist. You, with gumption, have learned the assembly the hard way and you've a whole set of good feelings about it that he's unlikely to have.

Anyway, the first technique for preventing the out-of-sequence-reassembly gumption trap is a notebook in which I write down the order of disassembly and note anything unusual that might give trouble in reassembly later on. This notebook gets plenty grease-smeared and ugly. But a number of times one or two words in it that didn't seem important when written down have prevented damage and saved hours of work. The notes should pay special attention to left-hand and right-hand and up-and-down orientations of parts, and color coding and positions of wires. If incidental parts look worn or damaged or loose this is the time to note it so that you can make all your parts purchases at the same time.

The second technique for preventing the out-of-sequence-reassembly gumption trap is newspapers opened out on the floor of the garage on which all the parts are laid left-to-right and top-to-bottom in the order in which you read a page. That way when you put it back together in reverse order the little screws and washers and pins that can be easily overlooked are brought to your attention as you need them.

Even with all these precautions, however, out-of-sequence-reassemblies sometimes occur and when they do you've got to watch the gumption. Watch out for gumption desperation, in which you hurry up wildly in an effort to restore gumption by making up for lost time. That just creates more mistakes. When you first see that you have to go back and take it apart all over again it's definitely time for that long break.

It's important to distinguish from these the reassemblies that were out of sequence because you lacked certain information. Frequently the whole reassembly process becomes a cut-and-try technique in which you have to take it apart to make a change and then put it together again to see if the change works. If it doesn't work, that isn't a setback because the information gained is a real progress.

But if you've made just a plain old dumb mistake in reassembly, some gumption can still be salvaged by the knowledge that the second disassembly and reassembly is likely to go much faster than the first one. You've unconsciously memorized all sorts of things you won't have to relearn.

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The intermittent failure setback is next. In this the thing that is wrong becomes right all of a sudden just as you start to fix it. Electrical short circuits are often in this class. The short occurs only when the machine's bouncing around. As soon as you stop everything's okay. It's almost impossible to fix it then. All you can do is try to get it to go wrong again and if it won't, forget it. Intermittents become gumption traps when they fool you into thinking you've really got the machine fixed. It's always a good idea on any job to wait a few hundred miles before coming to that conclusion. They're discouraging when they crop up again and again, but when they do you're no worse off than someone who goes to a commercial mechanic. In fact you're better off. They're much more of a gumption trap for the owner who has to drive his machine to the shop again and again and never get satisfaction. On your own machine you can study them over a long period of time, something a commercial mechanic can't do, and you can just carry around the tools you think you'll need until the intermittent happens again, and then, when it happens, stop and work on it.

When intermittents recur, try to correlate them with other things the cycle is doing. Do the misfires, for example, occur only on bumps, only on turns, only on acceleration? Only on hot days? These correlations are clues for cause-and-effect hypotheses. In some intermittents you have to resign yourself to a long fishing expedition, but no matter how tedious that gets it's never as tedious as taking the machine to a commercial mechanic five times. I'm tempted to go into long detail about "Intermittents I Have Known" with a blow-by-blow description of how these were solved. But this gets like those fishing stories, of interest mainly to the fisherman, who doesn't quite catch on to why everybody yawns. He enjoyed it.

Next to misassemblies and intermittents I think the most common external gumption trap is the parts setback. Here a person who does his own work can get depressed in a number of ways. Parts are something you never plan on buying when you originally get the machine. Dealers like to keep their inventories small. Wholesalers are slow and always understaffed in the spring when everybody buys motorcycle parts.

The pricing on parts is the second part of this gumption trap. It's a well-known industrial policy to price the original equipment competitively, because the customer can always go somewhere else, but on parts to overprice and clean up. The price of the part is not only jacked up way beyond its new price; you get a special price because you're not a commercial mechanic. This is a sly arrangement that allows the commercial mechanic to get rich by putting in parts that aren't needed.

One more hurdle yet. The part may not fit. Parts lists always contain mistakes. Make and model changes are confusing. Out-of-tolerance parts runs sometimes get through quality control because there's no operating checkout at the factory. Some of the parts you buy are made by specialty houses who don't have access to the engineering data needed to make them right. Sometimes they get confused about make and model changes. Sometimes the parts man you're dealing with jots down the wrong number. Sometimes you don't give him the right identification. But it's always a major gumption trap to get all the way home and discover that a new part won't work.

The parts traps may be overcome by a combination of a number of techniques. First, if there's more than one supplier in town by all means choose the one with the most cooperative parts man. Get to know him on a first-name basis. Often he will have been a mechanic once himself and can provide a lot of information you need.

Keep an eye out for price cutters and give them a try. Some of them have good deals. Auto stores and mail-order houses frequently stock the commoner cycle parts at prices way below those of the cycle dealers. You can buy roller chain from chain manufacturers, for example, at way below the inflated cycle-shop prices.

Always take the old part with you to prevent getting a wrong part. Take along some machinist's calipers for comparing dimensions.

Finally, if you're as exasperated as I am by the parts problem and have some money to invest, you can

take up the really fascinating hobby of machining your own parts. I have a little 6-by-18-inch lathe with a milling attachment and a full complement of welding equipment: arc, heli-arc, gas and mini-gas for this kind of work. With the welding equipment you can build up worn surfaces with better than original metal and then machine it back to tolerance with carbide tools. You can't really believe how versatile that lathe-plus-milling-plus-welding arrangement is until you've used it. If you can't do the job directly you can always make something that will do it. The work of machining a part is very slow, and some parts, such as ball bearings, you're never going to machine, but you'd be amazed at how you can modify parts designs so that you can make them with your equipment, and the work isn't nearly as slow or frustrating as a wait for some smirking parts man to send away to the factory. And the work is gumption building, not gumption destroying. To run a cycle with parts in it you've made yourself gives you a special feeling you can't possibly get from strictly store-bought parts.

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Well, those were the commonest setbacks I can think of: out-of-sequence reassembly, intermittent failure and parts problems. But although setbacks are the commonest gumption traps they're only the external cause of gumption loss. Time now to consider some of the internal gumption traps that operate at the same time.

As the course description of gumptionology indicated, this internal part of the field can be broken down into three main types of internal gumption traps: those that block affective understanding, called "value traps"; those that block cognitive understanding, called "truth traps"; and those that block psychomotor behavior, called "muscle traps." The value traps are by far the largest and the most dangerous group.

Of the value traps, the most widespread and pernicious is value rigidity. This is an inability to revalue what one sees because of commitment to previous values. In motorcycle maintenance, you must rediscover what you do as you go. Rigid values make this impossible.

The typical situation is that the motorcycle doesn't work. The facts are there but you don't see them. You're looking right at them, but they don't yet have enough value. [. . .] Quality, value, creates the subjects and objects of the world. The facts do not exist until value has created them. If your values are rigid you can't really learn new facts.

This often shows up in premature diagnosis, when you're sure you know what the trouble is, and then when it isn't, you're stuck. Then you've got to find some new clues, but before you can find them you've got to clear your head of old opinions. If you're plagued with value rigidity you can fail to see the real answer even when it's staring you right in the face because you can't see the new answer's importance.

The birth of a new fact is always a wonderful thing to experience. It's dualistically called a "discovery" because of the presumption that it has an existence independent of anyone's awareness of it. When it comes along, it always has, at first, a low value. Then, depending on the value-looseness of the observer and the potential quality of the fact, its value increases, either slowly or rapidly, or the value wanes and the fact disappears.

The overwhelming majority of facts, the sights and sounds that are around us every second and the relationships among them and everything in our memory. . . these have no quality, in fact have a negative quality. If they were all present at once our consciousness would be so jammed with meaningless data we couldn't think or act. So we preselect on the basis of quality [. . .].

What you have to do, if you get caught in this gumption trap of value rigidity, is slow down. . . you're going to have to slow down anyway whether you want to or not. . . but slow down deliberately and go over ground

that you've been over before to see if the things you thought were important were really important and to—well—just stare at the machine. There's nothing wrong with that. Just live with it for a while. Watch it the way you watch a line when fishing and before long, as sure as you live, you'll get a little nibble, a little fact asking in a timid, humble way if you're interested in it. That's the way the world keeps on happening. Be interested in it.

At first try to understand this new fact not so much in terms of your big problem as for its own sake. That problem may not be as big as you think it is. And that fact may not be as small as you think it is. It may not be the fact you want but at least you should be very sure of that before you send the fact away. Often before you send it away you will discover it has friends who are right next to it and are watching to see what your response is. Among the friends may be the exact fact you are looking for.

After a while you may find that the nibbles you get are more interesting than your original purpose of fixing the machine. When that happens you've reached a kind of point of arrival. Then you're no longer strictly a motorcycle mechanic, you're also a motorcycle scientist, and you've completely conquered the gumption trap of value rigidity.

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I keep wanting to go back to that analogy of fishing for facts. I can just see somebody asking with great frustration, "Yes, but which facts do you fish for? There's got to be more to it than that."

But the answer is that if you know which facts you're fishing for you're no longer fishing. You've caught them. I'm trying to think of a specific example.

All kinds of examples from cycle maintenance could be given, but the most striking example of value rigidity I can think of is the old South Indian Monkey Trap, which depends on value rigidity for its effectiveness. The trap consists of a hollowed-out coconut chained to a stake. The coconut has some rice inside which can be grabbed through a small hole. The hole is big enough so that the monkey's hand can go in, but too small for his fist with rice in it to come out. The monkey reaches in and is suddenly trapped. . . by nothing more than his own value rigidity. He can't revalue the rice. He cannot see that freedom without rice is more valuable than capture with it. The villagers are coming to get him and take him away. They're coming closer—closer!—now! What general advice. . . not specific advice. . . but what general advice would you give the poor monkey in circumstances like this?

Well, I think you might say exactly what I've been saying about value rigidity, with perhaps a little extra urgency. There is a fact this monkey should know: if he opens his hand he's free. But how is he going to discover this fact? By removing the value rigidity that rates rice above freedom. How is he going to do that? Well, he should somehow try to slow down deliberately and go over ground that he has been over before and see if things he thought were important really were important and, well, stop yanking and just stare at the coconut for a while. Before long he should get a nibble from a little fact wondering if he is interested in it. He should try to understand this fact not so much in terms of his big problem as for its own sake. That problem may not be as big as he thinks it is. That fact may not be as small as he thinks it is either. That's about all the general information you can give him.

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The next one is important. It's the internal gumption trap of ego. Ego isn't entirely separate from value rigidity but one of the many causes of it.

If you have a high evaluation of yourself then your ability to recognize new facts is weakened. Your ego isolates you from the quality reality. When the facts show that you've just goofed, you're not as likely to admit it. When false information makes you look good, you're likely to believe it. On any mechanical repair job ego comes in for rough treatment. You're always being fooled, you're always making mistakes, and a mechanic who has a big ego to defend is at a terrific disadvantage. If you know enough mechanics to think of them as a group, and your observations coincide with mine, I think you'll agree that mechanics tend to be rather modest and quiet. There are exceptions, but generally if they're not quiet and modest at first, the work seems to make them that way. And skeptical. Attentive, but skeptical, But not egoistic. There's no way to bullshit your way into looking good on a mechanical repair job, except with someone who doesn't know what you're doing.

I was going to say that the machine doesn't respond to your personality, but it does respond to your personality. It's just that the personality that it responds to is your real personality, the one that genuinely feels and reasons and acts, rather than any false, blown-up personality images your ego may conjure up. These false images are deflated so rapidly and completely you're bound to be very discouraged very soon if you've derived your gumption from ego rather than quality.

If modesty doesn't come easily or naturally to you, one way out of this trap is to fake the attitude of modesty anyway. If you just deliberately assume you're not much good, then your gumption gets a boost when the facts prove this assumption is correct. This way you can keep going until the time comes when the facts prove this assumption is incorrect.

Anxiety, the next gumption trap, is sort of the opposite of ego. You're so sure you'll do everything wrong you're afraid to do anything at all. Often this, rather than "laziness," is the real reason you find it hard to get started. This gumption trap of anxiety, which results from overmotivation, can lead to all kinds of errors of excessive fussiness. You fix things that don't need fixing, and chase after imaginary ailments. You jump to wild conclusions and build all kinds of errors into the machine because of your own nervousness. These errors, when made, tend to confirm your original underestimation of yourself. This leads to more errors, which lead to more underestimation, in a self-stoking cycle.

The best way to break this cycle, I think, is to work out your anxieties on paper. Read every book and magazine you can on the subject. Your anxiety makes this easy and the more you read the more you calm down. You should remember that it's peace of mind you're after and not just a fixed machine.

When beginning a repair job you can list everything you're going to do on little slips of paper which you then organize into proper sequence. You discover that you organize and then reorganize the sequence again and again as more and more ideas come to you. The time spent this way usually more than pays for itself in time saved on the machine and prevents you from doing fidgety things that create problems later on.

You can reduce your anxiety somewhat by facing the fact that there isn't a mechanic alive who doesn't louse up a job once in a while. The main difference between you and the commercial mechanics is that when they do it you don't hear about it. . . just pay for it, in additional costs prorated through all your bills. When you make the mistakes yourself, you at]east get the benefit of some education.

Boredom is the next gumption trap that comes to mind. This is the opposite of anxiety and commonly goes with ego problems. Boredom means you're off the quality track, you're not seeing things freshly, you've lost your "beginner's mind" and your motorcycle is in great danger. Boredom means your gumption supply is low and must be replenished before anything else is done.

When you're bored, stop! Go to a show. Turn on the TV. Call it a day. Do anything but work on that machine. If you don't stop, the next thing that happens is the Big Mistake, and then all the boredom plus the Big Mistake

combine together in one Sunday punch to knock all the gumption out of you and you are really stopped.

My favorite cure for boredom is sleep. It's very easy to get to sleep when bored and very hard to get bored after a long rest. My next favorite is coffee. I usually keep a pot plugged in while working on the machine. If these don't work it may mean deeper quality problems are bothering you and distracting you from what's before you. The boredom is a signal that you should turn your attention to these problems... that's what you're doing anyway... and control them before continuing on the motorcycle.

For me the most boring task is cleaning the machine. It seems like such a waste of time. It just gets dirty again the first time you ride it. [My friend] John always kept his BMW spic and span. It really did look nice, while mine's always a little ratty, it seems.

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One solution to boredom on certain kinds of jobs such as greasing and oil changing and tuning is to turn them into a kind of ritual. There's an esthetic to doing things that are unfamiliar and another esthetic to doing things that are familiar. I have heard that there are two kinds of welders: production welders, who don't like tricky setups and enjoy doing the same thing over and over again; and maintenance welders, who hate it when they have to do the same job twice. The advice was that if you hire a welder make sure which kind he is, because they're not interchangeable. I'm in that latter class, and that's probably why I enjoy troubleshooting more than most and dislike cleaning more than most. But I can do both when I have to and so can anyone else. When cleaning I do it the way people go to church... not so much to discover anything new, although I'm alert for new things, but mainly to reacquaint myself with the familiar. It's nice sometimes to go over familiar paths.

Zen has something to say about boredom. Its main practice of "just sitting" has got to be the world's most boring activity [...]. You don't do anything much; not move, not think, not care. What could be more boring? Yet in the center of all this boredom is the very thing Zen Buddhism seeks to teach. What is it? What is it at the very center of boredom that you're not seeing?

Impatience is close to boredom but always results from one cause: an underestimation of the amount of time the job will take. You never really know what will come up and very few jobs get done as quickly as planned. Impatience is the first reaction against a setback and can soon turn to anger if you're not careful.

Impatience is best handled by allowing an indefinite time for the job, particularly new jobs that require unfamiliar techniques; by doubling the allotted time when circumstances force time planning; and by scaling down the scope of what you want to do. Overall goals must be scaled down in importance and immediate goals must be scaled up. This requires value flexibility, and the value shift is usually accompanied by some loss of gumption, but it's a sacrifice that must be made. It's nothing like the loss of gumption that will occur if a Big Mistake caused by impatience occurs.

My favorite scaling-down exercise is cleaning up nuts and bolts and studs and tapped holes. I've got a phobia about crossed or jimmied or rust-jammed or dirt-jammed threads that cause nuts to turn slow or hard; and when I find one, I take its dimensions with a thread gauge and calipers, get out the taps and dies, recut the threads on it, then examine it and oil it and I have a whole new perspective on patience. Another one is cleaning up tools that have been used and not put away and are cluttering up the place. This is a good one because one of the first warning signs of impatience is frustration at not being able to lay your hand on the tool you need right away. If you just stop and put tools away neatly you will both find the tool and also scale down your impatience without wasting time or endangering the work.

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Well, that about does it for value traps. There's a whole lot more of them, of course. I've really only just touched on the subject to show what's there. Almost any mechanic could fill you in for hours on value traps he's discovered that I don't know anything about. You're bound to discover plenty of them for yourself on almost every job. Perhaps the best single thing to learn is to recognize a value trap when you're in it and work on that before you continue on the machine.

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I want to talk now about truth traps and muscle traps and then stop this Chautauqua for today.

Truth traps are concerned with data that are apprehended and are within [your mind]. For the most part these data are properly handled by conventional dualistic logic and the scientific method [. . .]. But there's one trap that isn't. . . the truth trap of yes-no logic.

Yes and no—this or that—one or zero. On the basis of this elementary two-term discrimination, all human knowledge is built up. The demonstration of this is the computer memory which stores all its knowledge in the form of binary information. It contains ones and zeros, that's all.

Because we're unaccustomed to it, we don't usually see that there's a third possible logical term equal to yes and no which is capable of expanding our understanding in an unrecognized direction. We don't even have a term for it, so I'll have to use the Japanese mu [□].

Mu means "no thing." [. . .] Mu simply says, "No class; not one, not zero, not yes, not no." It states that the context of the question is such that a yes or no answer is in error and should not be given. "Unask the question" is what it says.

Mu becomes appropriate when the context of the question becomes too small for the truth of the answer. When the Zen monk Joshu was asked whether a dog had a Buddha nature he said "Mu," meaning that if he answered either way he was answering incorrectly. The Buddha nature cannot be captured by yes or no questions.

That mu exists in the natural world investigated by science is evident. It's just that, as usual, we're trained not to see it by our heritage. For example, it's stated over and over again that computer circuits exhibit only two states, a voltage for "one" and a voltage for "zero." That's silly!

Any computer-electronics technician knows otherwise. Try to find a voltage representing one or zero when the power is off! The circuits are in a mu state. They aren't at one, they aren't at zero, they're in an indeterminate state that has no meaning in terms of ones or zeros. Readings of the voltmeter will show, in many cases, "floating ground" characteristics, in which the technician isn't reading characteristics of the computer circuits at all but characteristics of the voltmeter itself. What's happened is that the power-off condition is part of a context larger than the context in which the one zero states are considered universal. The question of one or zero has been "unasked." And there are plenty of other computer conditions besides a power-off condition in which mu answers are found because of larger contexts than the one-zero universality.

The dualistic mind tends to think of mu occurrences in nature as a kind of contextual cheating, or irrelevance, but mu is found throughout all scientific investigation, and nature doesn't cheat, and nature's answers are never irrelevant. It's a great mistake, a kind of dishonesty, to sweep nature's mu answers under the carpet. Recognition and valuation of these answers would do a lot to bring logical theory closer to experimental practice. Every laboratory scientist knows that very often his experimental results provide mu answers to the

yes-no questions the experiments were designed for. In these cases he considers the experiment poorly designed, chides himself for stupidity and at best considers the "wasted" experiment which has provided the mu answer to be a kind of wheel-spinning which might help prevent mistakes in the design of future yes-no experiments.

This low evaluation of the experiment which provided the mu answer isn't justified. The mu answer is an important one. It's told the scientist that the context of his question is too small for nature's answer and that he must enlarge the context of the question. That is a very important answer! His understanding of nature is tremendously improved by it, which was the purpose of the experiment in the first place. A very strong case can be made for the statement that science grows by its mu answers more than by its yes or no answer. Yes or no confirms or denies a hypothesis. Mu says the answer is beyond the hypothesis. Mu is the "phenomenon" that inspires scientific enquiry in the first place! There's nothing mysterious or esoteric about it. It's just that our culture has warped us to make a low value judgment of it.

In motorcycle maintenance the mu answer given by the machine to many of the diagnostic questions put to it is a major cause of gumption loss. It shouldn't be! When your answer to a test is indeterminate it means one of two things: that your test procedures aren't doing what you think they are or that your understanding of the context of the question needs to be enlarged. Check your tests and restudy the question. Don't throw away those mu answers! They're every bit as vital as the yes or no answers. They're more vital. They're the ones you grow on!

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The mu expansion is the only thing I want to say about truth traps at this time. Time to switch to the psychomotor traps. This is the domain of understanding which is most directly related to what happens to the machine.

Here by far the most frustrating gumption trap is inadequate tools. Nothing's quite so demoralizing as a tool hang-up. Buy good tools as you can afford them and you'll never regret it. If you want to save money don't overlook the newspaper want ads. Good tools, as a rule, don't wear out, and good secondhand tools are much better than inferior new ones. Study the tool catalogs. You can learn a lot from them.

Apart from bad tools, bad surroundings are a major gumption trap. Pay attention to adequate lighting. It's amazing the number of mistakes a little light can prevent.

Some physical discomfort is unpreventable, but a lot of it, such as that which occurs in surroundings that are too hot or too cold, can throw your evaluations way off if you aren't careful. If you're too cold, for example, you'll hurry and probably make mistakes. If you're too hot your anger threshold gets much lower. Avoid out-of-position work when possible. A small stool on either side of the cycle will increase your patience greatly and you'll be much less likely to damage the assemblies you're working on.

There's one psychomotor gumption trap, muscular insensitivity, which accounts for some real damage. It results in part from lack of kinesthesia, a failure to realize that although the externals of a cycle are rugged, inside the engine are delicate precision parts which can be easily damaged by muscular insensitivity. There's what's called "mechanic's feel," which is very obvious to those who know what it is, but hard to describe to those who don't; and when you see someone working on a machine who doesn't have it, you tend to suffer with the machine.

The mechanic's feel comes from a deep inner kinesthetic feeling for the elasticity of materials. Some materials, like ceramics, have very little, so that when you thread a porcelain fitting you're very careful not to apply

great pressures. Other materials, like steel, have tremendous elasticity, more than rubber, but in a range in which, unless you're working with large mechanical forces, the elasticity isn't apparent.

With nuts and bolts you're in the range of large mechanical forces and you should understand that within these ranges metals are elastic. When you take up a nut there's a point called "finger-tight" where there's contact but no takeup of elasticity. Then there's "snug," in which the easy surface elasticity is taken up. Then there's a range called "tight," in which all the elasticity is taken up. The force required to reach these three points is different for each size of nut and bolt, and different for lubricated bolts and for locknuts. The forces are different for steel and cast iron and brass and aluminum and plastics and ceramics. But a person with mechanic's feel knows when something's tight and stops. A person without it goes right on past and strips the threads or breaks the assembly.

A "mechanic's feel" implies not only an understanding for the elasticity of metal but for its softness. The insides of a motorcycle contain surfaces that are precise in some cases to as little as one ten-thousandth of an inch. If you drop them or get dirt on them or scratch them or bang them with a hammer they'll lose that precision. It's important to understand that the metal behind the surfaces can normally take great shock and stress but that the surfaces themselves cannot. When handling precision parts that are stuck or difficult to manipulate, a person with mechanic's feel will avoid damaging the surfaces and work with his tools on the nonprecision surfaces of the same part whenever possible. If he must work on the surfaces themselves, he'll always use softer surfaces to work them with. Brass hammers, plastic hammers, wood hammers, rubber hammers and lead hammers are all available for this work. Use them. Vise jaws can be fitted with plastic and copper and lead faces. Use these too. Handle precision parts gently. You'll never be sorry. If you have a tendency to bang things around, take more time and try to develop a little more respect for the accomplishment that a precision part represents.

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Maybe it's just the usual late afternoon letdown, but after all I've said about all these things today I just have a feeling that I've somehow talked around the point. Some could ask, "Well, if I get around all those gumption traps, then will I have the thing licked?"

The answer, of course, is no, you still haven't got anything licked. You've got to live right too. It's the way you live that predisposes you to avoid the traps and see the right facts. You want to know how to paint a perfect painting? It's easy. Make yourself perfect and then just paint naturally. That's the way all the experts do it. The making of a painting or the fixing of a motorcycle isn't separate from the rest of your existence. If you're a sloppy thinker the six days of the week you aren't working on your machine, what trap avoidances, what gimmicks, can make you all of a sudden sharp on the seventh? It all goes together.

But if you're a sloppy thinker six days a week and you really try to be sharp on the seventh, then maybe the next six days aren't going to be quite as sloppy as the preceding six. What I'm trying to come up with on these gumption traps I guess, is shortcuts to living right.

The real cycle you're working on is a cycle called yourself. The machine that appears to be "out there" and the person that appears to be "in here" are not two separate things. They grow toward quality or fall away from quality together.