well could not pick out the villains of overuse and decided to conduct another study to do so.

Over a six-month period, 80 patients in a hospital were told that if they felt anxious, all they had to do was speak to a nurse, and if she thought it was appropriate, she would give them some medicine for anxiety. Blackwell measured the anxiety in these patients, then derived a drug-seeking index, which was simply the number of requests they made divided by the number of days spent in the ward. So if a patient made three requests and stayed in the hospital three days, he or she had an index of three over three, which was one. In that way Blackwell was able to tell who had high drug-seeking indexes and who had low drug-seeking indexes.

His findings, which are in press with the Archives of General Psychiatry, are that, generally speaking, women sought drugs more than men, whites sought drugs more than blacks, but all the patients' requests for anxiety drugs closely related to their levels of anxiety. In other words, the patients did not use excessive amounts of anxiety drugs although the drugs were made freely available to them. If these findings are put in the context of Blackwell's earlier findings, it is the physician who is the major contributor to overprescribing, not the patient.

What happens, the Cincinnati psychiatrist explained to Science News, is that many physicians are short of time, see that patients are anxious yet have no apparent physical cause for their anxiety and prescribe minor tranquilizers for them. Everything that happens then—the patients' expectation that a drug will efface anxiety, the effects of reassurance from the physician and the tendency of a patient to get better because his or her lifestyle has changed—all that gets attributed to anxiety drugs, first by patients, but ultimately by physicians.

Says Blackwell, "The more you do it, the more it works, and the more you do it. I call that the 'Catch 22' of psychopharmacology." □

Is the universe a vacuum-fluctuation zero?

"Nothing from nothing is still nothing," runs an old schoolchild's subtraction rule. Cosmologists who believe in the big-bang origin of the universe have the opposite problem, that of getting something from nothing. In the big-bang picture there was a zero point of time. Before time zero, nothing existed; after time zero, the universe existed.

There is a basic law of physics that says you can't get away with this: the law of conservation of matter-energy. According to the law matter and energy can be transmuted into each other, but the total amount of matter and energy remains the same. Matter-energy can neither be created nor destroyed. But the big bang would create it out of nothing.

Some cosmologists get around the difficulty by postulating that the universe's existence is eternal; it alternately expands and contracts like a bellows and goes on doing this for all eternity. The problem with this proposal as Edward P. Tryon of Hunter College of the City University of New York points out in the Dec. 14 Nature is that "there is . . . no known mechanism by which the universe might bounce back from a contraction."

To solve the dilemma Tryon suggests that the universe is indeed a violation of the law of conservation of matter-energy, but one that happens to be sanctioned by the laws of quantum mechanics, a so-called vacuum fluctuation. It happens in theoretical quantum mechanics that a group of particles, say a photon, a positron and an electron may appear spontaneously out of a perfect vacuum. This is a violation of the conservation of matter-energy, but it is permitted by a basic principle of quantum mechanics, the Heisenberg uncertainty principle, so long as the particles in question annihilate each other and return to nothing in a very short time, usually a time too short for their existence to be noted.

The uncertainty principle describes a basic fact of life in the microscopic world: When we try to measure something, we change what we measure. For example, we see the position of an object by recording on the retinas of our eyes the photons reflected from the object. Bouncing photons off a brick wall does not affect the wall much, but if we try to see electrons with photons we find that in the collision the electrons are dealt a blow that makes them recoil, changing their velocities. Heisenberg's principle says that there is therefore a reciprocal uncertainty in the velocity and position of an object. The uncertainty of position is inversely proportional to the uncertainty of velocity. (The constant of proportionality is Planck's constant.) The closer we know the position, the more uncertain we are about the velocity, and vice versa. A similar reciprocal uncertainty appears in the case of a fluctuation in the energy of some event and the time that fluctuation lasts. Thus a vacuum fluctuation of the sort described can occur provided that the energy change (from the zero of the perfect vacuum) lasts no longer than the uncertainty principle allows. The bigger the energy involved, the shorter the time.

Tryon proposes that the universe is a fluctuation of the vacuum, "the vacuum of some larger space in which our universe is embedded."

Granted therefore that quantum mechanics allows vacuum fluctuations to exist, for the universe to be one requires it to satisfy some rather stringent criteria. In a certain metaphysical sense it must be nothing from nothing to yield nothing. It must add up to zero with regard to electric charge (the total positive must equal the total negative), and it must add up to zero with regard to matter and antimatter (equal amounts of each). There is a good chance that the universe satisfies these two conditions. In fact most cosmologists start out by assuming that it does. But there is a still more serious problem: the time and energy relation in the uncertainty principle.

The universe has been around for a long time, something like ten billion years. To be a vacuum fluctuation that satisfies the uncertainty principle, it would have to have very little matter-energy. But it seems to have a lot.

In his Nature article Tryon shows how to get around this. If we can equate the positive energy residing in the rest masses of the objects in the universe with the negative potential energy latent in the gravitational forces that exist among the various bodies, we can arrive at a universe with a net matter-energy content of zero, a universe that can exist indefinitely according to the uncertainty principle. Tryon shows that the equation works if the universe is closed, that is, if it has enough mass so that the gravitational forces will eventually halt its expansion and bring about a contraction.

All well and good, Tryon can provide us with a zero-energy universe, and it may fit the observations we make. But why should we be in just this one out of the endless number of possible vacuum fluctuations that might occur, and why should it be such a big one since vacuum fluctuations are by their nature likely to be microscopic? Tryon's basic answer is that it is "simply one of those things which happen from time to time." And then he elaborates just a little:

". . . any universe in which sentient beings find themselves is necessarily hospitable to sentient beings. I do not claim that universes like ours occur frequently, merely that the expected frequency is non-zero. Vacuum fluctuations on the scale of our universe are probably quite rare. The logic of the situation dictates, however, that observers always find themselves in universes capable of generating life, and such universes are impressively large." □