Book Reviews

The Lunar Effect: Biological Tides and Human Emotions. By Arnold L. Lieber, M.D. Anchor Press/Doubleday, New York, 1978. 168 pp. $7.95.

Reviewed by George O. Abell

The cycle of phases of the moon, and full moon in particular, are associated with a plethora of folklore, ranging from lycanthropy (werewolfism) to the frequency of human births. Certainly there are real effects of the moon—tides and eclipses, for example—and it is entirely possible that some lunar influences exist that have not yet been recognized by the scientific community.

One person who believes this to be the case is Arnold Lieber, a Miami psychiatrist who has recently described his ideas in *The Lunar Effect*, prepared in collaboration with writer Jerome Agel, who is listed as "producer."

Lieber, noting what he regards to be especially anomalous activity of many mental patients during the time of full moon, theorizes that the moon's gravitational pull produces "biological tides" in man and other organisms. The human body is 80 percent water, he reminds us, so that erratic behavior may result from tidal action on bodily fluids analogous to the action of the moon on the oceans of the earth. If so, he argues that the effect should be most pronounced at the time of full and new moon, when ocean tides are highest.

To test his theory, Lieber, and an associate, Carolyn Sherin, investigated the incidence of violent crime. In a sample of 1,892 homicides over a 15-year period in Dade County (Miami), they found a peak in the number occurring on the day of full moon, and another peak two days after new moon. In a second sample of 2,008 homicides over a 13-year period in Cuyahoga County (Cleveland) they found one peak three days after full moon and another two days after new moon. Lieber suspected that the time displacement between the peaks in the two samples might be due to a phase lag associated with latitude.

Other investigators, in particular Alex Pokorny, professor of psychiatry at Baylor College of Medicine, have been unable to replicate Lieber's finding of a peak in the number of homicides at full or new moon in investigations of several independent samples. Lieber argues, however, that the studies of Pokorny and others consider only the time of death, while his own statistics are based on the

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time of initial injury. To verify this point, Lieber reexamined the homicides in Dade and Cuyahoga counties but used time of death rather than assault, and he combined these data with a much larger sample of 10,000 homicides in New York City, which listed only death times. He found these death times to have no correlation with lunar phase.

Encouraged by his findings, in late summer 1973 Lieber predicted that "an increase in accidents of all kinds" and "an increase in the number of homicides" would occur in January and February of 1974, when the "Earth, the Moon, and the Sun would be in a straight line . . . with the Moon at perigee unusually close to Earth" (pages 41-42). He reports, "The murder toll for the first three weeks of the new year was three times higher than for all of January 1973," and he describes several violent events over the world that occurred during "this time of cosmic coincidence." He points out, further, that deaths in Dade County, psychiatric emergency-room visits, and admissions to the psychiatric institute at Jackson Memorial Hospital were all unusually high during the first three months of 1974.

Needless to say, astrologers are delighted with the appearance of Lieber's book, not because it confirms predictions of traditional astrology, but because it argues for cosmic influences, which, at least to astrologers, makes their doctrine seem more credible. And on the face of it, Lieber's mass of evidence and statistics seems very impressive indeed. It is, therefore, worth a second look.

Lieber believes the key to lunar influences is found in the tides the moon produces on biological organisms. Tides are gravitational phenomena, and gravitation is an attraction between all material bodies. That attraction is strongest for bodies close together, but drops off rapidly the greater their separation. Now the reason the moon produces tides is that, as astronomical bodies go, it is relatively close to the earth, so that its pull on the side of the earth nearest it is slightly stronger than on the side of the earth farthest from it. The result is that the moon tries to distort the earth, stretching it into a "football" shape, with the long dimension pointing toward the moon. The solid earth actually does distort in this way, but only by about 20 centimeters. (At the same time, the earth, similarly, distorts the moon.)

This small tidal distortion of the rigid earth is not great enough to bring the forces on it into equilibrium; consequently, the water on the surface tries to flow in such a way as to pile up both under the moon and on the far side of the earth from the moon. The earth is rotating with respect to the moon, however, so that the directions of the tide-raising forces on the oceans reverse twice each day—far too rapidly for the water to have time to flow significantly over the surface of the earth. But these forces, switching back and forth as they do, set the oceans sloshing back and forth in their basins, so that at most places along the shores the tides do "come in and go out" twice each day.

The heights of the tides produced by the moon have nothing to do with its phase (whether it is new, full, or whatever), but they do depend on the moon's distance. Its orbit is eccentric so its distance varies, and once each month (actually 27.55 days) it is 10 percent closer to us than it is two weeks later. At those monthly times of the moon's nearest approach (perigee) the tides produced

are more than 30 percent higher than when the moon is at its farthest (apogee)

The sun also produces tides, but the sun is 400 times as far away as the moon is, so even though its total gravitational pull on the earth is more than 100 times that of the moon, the *difference* of its pull on different sides of the earth—that is, its tidal force—has less than half the effect of the moon. Still, when the sun, earth, and moon are in a line, as they are every two weeks (at either full or new moon), their tidal forces combine and produce higher than average tides (spring tides), while when they are at right angles to each other in the sky (first or third quarter) their tides partly cancel each other (neap tides). Thus it is not that the moon's gravitational pull is stronger at new and full moon (as Lieber states), but that its tidal force joins that of the sun. This is why Lieber attaches significance to the full and new moon, although the difference between spring and neap tides is not dramatic; in fact, it is comparable to the effect of the moon's changing distance from the earth.

Even so, the effect of the moon on the oceans is important only because the tidal force acts over the 8,000-mile diameter of the earth. What effect has the moon on a man or woman? The earth's pull on a person is called his *weight*. On the average the moon's gravitational pull amounts to only three parts in a million of one's weight; for a 200-pound man, this is about 0.01 ounce. But the moon's pull on you isn't even relevant, because it also pulls on the earth. What might matter is the difference between your weight in the presence of the moon's gravitational effect and what it would be if there were no moon. At the most, that difference amounts to only 0.01 gram, or about 0.0003 ounces, less than the effect of a mosquito on your shoulder.

But even the moon's effect on your weight is not what *really* counts. If there is anything to the idea of biological tides, it is due to the difference of the moon's pull on different parts of your body, which is pretty small compared to the 8,000-mile diameter of the earth. It works out that the effect on your blood (or any fluid in your body whose flow or circulation could be distorted by the moon) is about one part in 3×10^{13} (or 30 trillion) of the weight of that fluid. The copy of the SKEPTICAL INQUIRER now in your hand exerts a tidal force on your body that is tens of thousands of times stronger than that of the moon.

In short, we would not expect tides by the moon to have a significant effect on human behavior, and would, I should think, be very surprised to find a lunar influence of the sort Lieber proposes. On the other hand, if he presents convincing evidence for a lunar effect, we should certainly take a strong interest, for such an effect, if real, could signal new science. So how convincing is Lieber's case?

First, I find it strange that Lieber implies (p. 16) that the effect is obvious and that nearly everyone is aware that, for example, people in mental institutions act strangely at full moon, but then (p. 18) says that it is a small effect that requires large samples to reveal. Still, what about those large samples?

Lieber does not give the actual numbers of homicides in his Dade County and Cuyahoga County samples, either by calendar date or by date in the lunar cycle; he only shows a graph of the data. Therefore, I looked up his and Sherin's original paper (*American Journal of Psychiatry,* 129:69-74, 1972) and read the numbers off their plots as well as I could. A simple χ^2 test showed that the

distribution of Dade County homicides through the lunar cycle did not differ from what one would expect by chance at least 7 percent of the time, and that the actual day-to-day fluctuations are quite in line with chance. Although there was a peak at full moon, I would judge the peak as typical of random noise. And the second peak in the lunar cycle was not at new moon, as predicted, but two days later.

Now, Lieber (in his and Sherin's paper) points out that if one asks the probability of obtaining peaks within one (or two) days of the times of the observed peaks, that probability is low. But this is a fallacious way to test a matter statistically. Every random distribution has random fluctuations. One cannot simply pick out the high noise peaks and ask what is the probability of finding them exactly where they occurred; it is already *known* that there are peaks at those places. It is like drawing a card from a deck, noting that it is the four of hearts, and arguing that the chance was only one in 52 of drawing that particular card; although true, it is exactly the same as the probability of drawing any other card named in advance, and of course does not indicate anything remarkable about the deck or drawing. Lieber could have made the case seem all the more remarkable by noting that there were 1,892 homicides in Dade County during the 480 million seconds (15 years) of the period sampled, and that the chance of a homicide occurring during the particular second that, say, homicide number 87 occurred is only 1,892 divided by 480 million, or about one in 200,000. Of course each homicide had to occur during *some* second. One cannot test the chance occurrence of an event already known to have occurred; what he is doing is calculating the probability of the identical thing happening again in a given random trial. In short, I find the Dade homicide data typical of noise, and unconvincing.

I am also not convinced by Lieber's explanation of why Pokorny failed to replicate his results. According to Pokorny, 85 percent of homicide victims die within one hour of injury, but Lieber contends that the 15 percent who die later would destroy the subtle correlation he finds. On the other hand in the New York City sample of 10,000 homicides one would expect that surely the 85 percent who die at once would show some correlation with full or new moon if the lunar effect were real.

How about the Cuyahoga sample? There, too, the day-to-day fluctuations of numbers of homicides within the lunar cycle are within what is expected by chance. The actual distribution of events is somewhat unusual; it differs from what is expected by chance more often than occurs only 3 percent of the time. Still, that is not overly surprising. And more to the point, the Cuyahoga sample has a very different distribution from that of Dade County. There are three peaks in the Cuyahoga County sample, the second highest being near third quarter moon, and the third highest is the one two days after new moon. Moreover, the peak near full moon lagged three days behind the peak in the Dade County sample, while the one near new moon had no lag at all. Lieber seems to be changing the rules for what constitutes agreement.

Now every year tens of thousands of reports of experiments and observations are published. Some are sound, but many are based on poor experimental

techniques, on improper controls, on biased or selected data, and sometimes are even fudged. It is not an uncommon practice for those with novel theories to comb the scientific literature for results that seem to support their theses. There is an old adage, "If ye seek hard enough, ye shall probably find." Among the many thousands of accounts to choose from, it is indeed not rare to find two or three that will serve a cause.

Lieber found what he needed in the studies of the metabolic activity of hamsters by Northwestern University biologist Frank Brown. Brown is himself somewhat of a maverick. He has been studying rhythms of various kinds in living organisms. Brown holds that these rhythms are externally stimulated—say by the sun or moon—whereas most of his colleagues are of the opinion that, while natural selection may have favored evolution of rhythms that are in step with environmental cycles, the actual timing is controlled by internal clocks in the organisms. An example is the familiar jet lag that most of us feel after an air trip from Europe to the United States; for several days our internal clocks keep waking us in the wee hours until we manage to get those clocks reset to our workaday cycle.

The activity Brown measured in his hamsters roughly matched, in lunar-phase cycle, the Cuyahoga County fluctuations in homicide rate. I measured the correlation between the two and found the coefficient to be a significant 0.5; but remember that the hamster study was selected because it did resemble the Cuyahoga murder data. It hardly provides convincing proof of the totally unexpected theory of biological tides.

Lieber's attempt to make a case out of violent activity in Miami in early 1974 involves a misunderstanding of elementary astronomy. When new or full moon occurs while the moon is also at its nearest (perigee), the spring tides are especially high. The moon was indeed near perigee at the full moons occurring on January 8, February 6, and March 8, 1974, and the corresponding spring tides were large ones. However, these high tides occur only for a few days; the moon was actually at its farthest (apogee) during the spring tides corresponding to new moon on January 23, February 22, and March 23, so those tides were below average for spring tides. During a 27.55-day period the moon goes through all of its possible distances.

Lieber reports (pp. 42-43) that "all hell broke loose, especially during the first two weeks of January, with the moon rocking only 217,000 miles from Earth." (Actually, during that period the moon's distance from the center of the earth varied from 221,564 miles to 246,085 miles.) Lieber then describes nine murders that occurred in that period in Miami—but without giving the dates, and he mentions some isolated acts of violence elsewhere in the world.

To support his theory, Lieber would have to demonstrate that violence in all parts of the world was significantly increased, not just during a two- or three-week period but within a day or two of those full moons when the moon was near perigee. Meanwhile, violence should have been lower than typical during the intervening new moons, when the moon was at apogee.

In Chapters 3 through 8 of *The Lunar Effect* Lieber describes a host of phenomena allegedly or possibly associated with the moon, including Harry

Rounds's study of blood factors in cockroaches (blood in cockroaches?), the human menstrual cycle, birthrates, geophysical effects, "wolfish" tendencies in man, and even disappearances in the Bermuda Triangle.

I am highly skeptical of even the human menstrual cycle having anything to do with the moon, despite widespread opinion to the contrary (and on page 52 of *The Lunar Effect*). The moon's cycle of phases is 29.53 days, while the human female menstrual cycle averages 28 days (although it varies among women and from time to time with individual women); this is hardly even a good coincidence! The corresponding estrous cycles of some other mammals are 28 days for opossums, 11 days for guinea pigs, 16 to 17 days for sheep, 20 to 22 days for sows, 21 days for cows and mares, 24 to 26 days for macaque monkeys, 37 days for chimpanzees, and only 5 days for rats and mice. One could argue, I suppose, that the human female, being more intelligent and perhaps more aware of her environment, adapted to a cycle close to that of the moon, while lower animals did not. But then the 28-day period for the opossum must be a coincidence, and if it is a coincidence for opossums, why not for humans?

Lieber accuses science of having prejudice against a lunar effect. I cannot imagine why such a prejudice should exist; scientists I know would be overjoyed to find a significant new correlation and to achieve some professional acclaim for their discovery. I think most of us are quite open-minded about the possibility of undiscovered lunar influences—especially psychological ones. But scientists do tend to be prejudiced against faulty statistical treatments, teleological reasoning, biased selection of data, and the adoption of farfetched arguments at the expense of far simpler ones to explain phenomena.

My impression is that Arnold Lieber is sincere in his attempt to investigate what seem to him to be interesting effects, and I do not regard *The Lunar Effect* as pseudoscience in the usual sense. But it is certainly very bad science. •