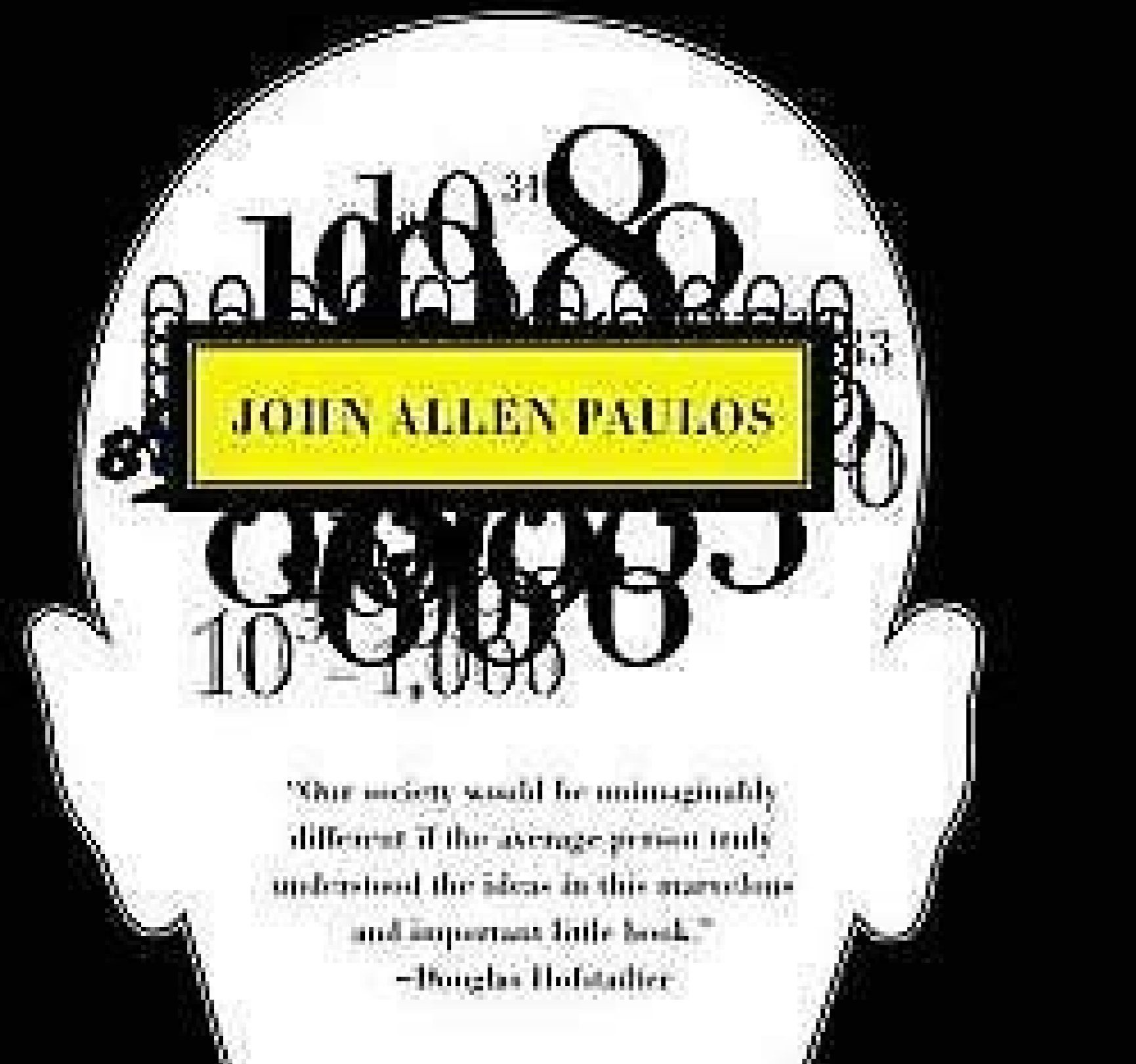


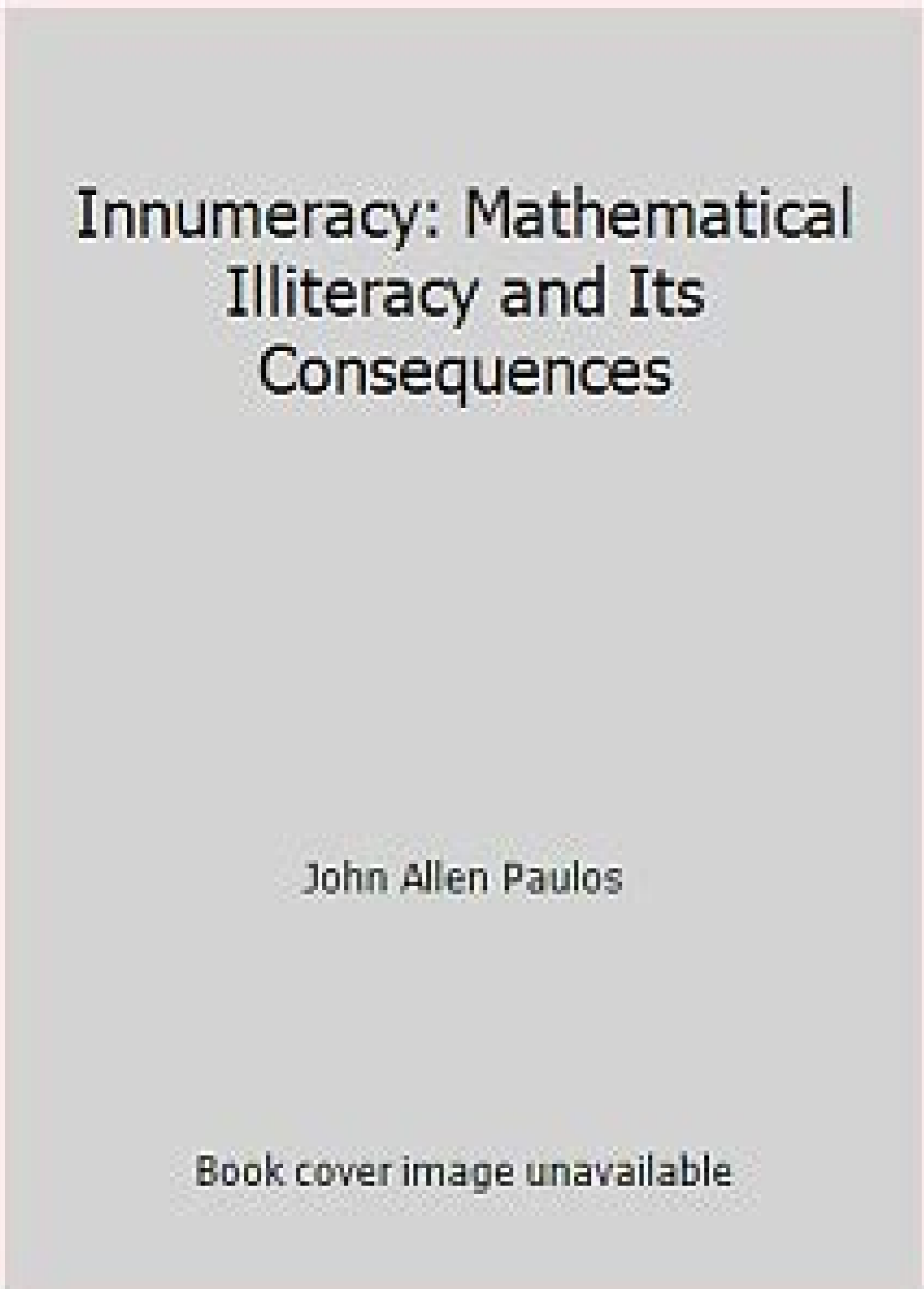
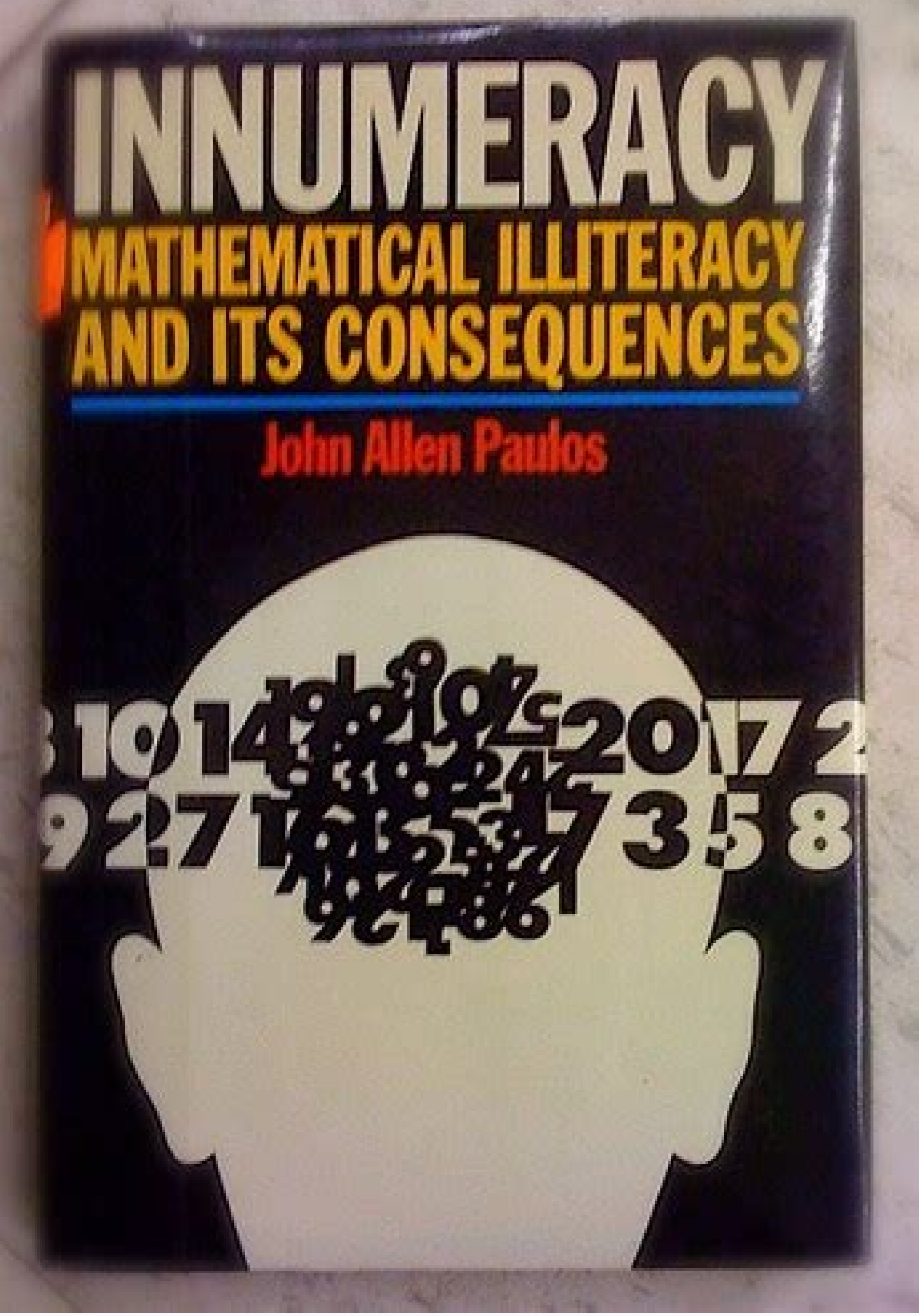
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24 Innumeracy Examples from the Book1/ TV weathercaster announced that there was a 50 percent chance of rain for Saturday and a 50 percent chance for Sunday, and concluded that there was therefore a 100 percent chance of rain that weekend.2/ I once had a conversation with a doctor who, within approximately twenty minutes, stated that a certain procedure he was contemplating (a) had a one-chance-in-a-million risk associated with it; (b) was 99 percent safe; and (c) usually went quite well.3/ It t 24 Innumeracy Examples from the Book1/ TV weathercaster announced that there was a 50 percent chance of rain for Saturday and a 50 percent chance for Sunday, and concluded that there was therefore a 100 percent chance of rain that weekend.2/ I once had a conversation with a doctor who, within approximately twenty minutes, stated that a certain procedure he was contemplating (a) had a one-chance-in-a-million risk associated with it; (b) was 99 percent safe; and (c) usually went quite well.3/ It takes only about eleven and a half days for a million seconds to tick away, whereas almost thirty-two years are required for a billion seconds to pass, gives one a better grasp of the relative magnitudes of these two common numbers. What about trillions? Modern Homo sapiens is probably less than 10 trillion seconds old.4/ Two strangers from opposite sides of the United States sit next to each other on a business trip to Milwaukee and discover that the wife of one of them was in the tennis camp run by an acquaintance of the other. This sort of coincidence is surprisingly common. If we assume each of the approximately 200 million adults in the United States knows about 1,500 people, and that these 1,500 people are reasonably spread out around the country, then the probability is about one in a hundred that they will have an acquaintance in common, and more than ninety-nine in a hundred that they will be linked by a chain of two intermediates.5/ There's always enough random success to justify almost anything to someone who wants to believe. 6/ Some would-be adviser puts a logo on some fancy stationery and sends out 32,000 letters to potential investors in a stock index. The letters tell of his company's elaborate computer model, his financial expertise, and inside contacts. In 16,000 of these letters, he predicts the index will rise, and in the other 16,000, he predicts a decline. No matter whether the index rises or falls, a follow-up letter is sent, but only to the 16,000 people who initially received a correct 'prediction.' To 8,000 of them, a rise is predicted for the next week; to the other 8,000, a decline. Whatever happens now, 8,000 people will have received two correct predictions. Again, to these 8,000 people only, letters are sent concerning the index's performance the following week: 4,000 predicting a rise; 4,000, a decline. Whatever the outcome, 4,000 people have now received three straight correct predictions. This is iterated a few more times until 500 people have received six straight correct 'predictions.' These 500 people are now reminded of this and told that in order to continue to receive this valuable information for the seventh week they must each contribute \$500. If they all pay, that's \$250,000 for our adviser.7/ There is a strong general tendency to filter out the bad and the failed and to focus on the good and the successful. Casinos encourage this tendency by making sure that every quarter that's won in a slot machine causes lights to blink and makes its own little tinkle in the metal tray. Seeing all the lights and hearing all the tinkles, it's not hard to get the impression that everyone's winning. Losses or failures are silent.8/ Because people usually focus upon winners and extremes whether they be in sports, the arts, or the sciences, there's always a tendency to denigrate today's sports figures, artists, and scientists by comparing them with extraordinary cases. A related consequence is that international news is usually worse than national news, which in turn is usually worse than state news, which is worse than local news, which is worse than the news in your particular neighborhood.9/ Coincidences or extreme values catch the eye, but average or 'expected' values are generally more informative.10/ Astrology maintains that the gravitational attraction of the planets at the time of one's birth somehow has an effect on one's personality. This seems very difficult to swallow, for two reasons: (a) no physical or neurophysiological mechanism through which this gravitational (or another sort of) attraction is supposed to act is ever even hinted at, much less explained; and (b) the gravitational pull of the delivering obstetrician far outweighs that of the planet or planets involved. Remember that the gravitational force an object exerts on a body - say, a newborn baby - is proportional to the object's mass but inversely proportional to the square of the distance of the object from the body - in this case, the baby. Does this mean that fat obstetricians deliver babies that have one set of personality characteristics, and skinny ones deliver babies that have quite different characteristics? These deficiencies of an astrological theory are less visible to the innumerate, who are not likely to concern themselves with mechanisms, and who are seldom interested in comparing magnitudes.11/ Most diseases or conditions (a) improve by themselves; (b) are self-limiting; or (c) even if fatal, seldom follow a strictly downward spiral. In each case, intervention, no matter how worthless, can appear to be quite efficacious. This becomes clearer if you assume the point of view of a knowing practitioner of fraudulent medicine. To take advantage of the natural ups and downs of any disease (as well as of any placebo effect), it's best to begin your worthless treatment when the patient is getting worse. In this way, anything that happens can more easily be attributed to your wonderful and probably expensive intervention. If the patient improves, you take credit; if he remains stable, your treatment stopped his downward course. On the other hand, if the patient worsens, the dosage or intensity of the treatment was not great enough; if he dies, he delayed too long in coming to you. In any case, the few instances in which your intervention is successful will likely be remembered (not so few, if the disease is self-limiting), while the vast majority of failures will be forgotten and buried. Chance provides more than enough variation to account for the sprinkling of successes that will occur with almost any treatment; indeed, it would be a miracle if there weren't any 'miracle cures.' 12/ What's wrong with the following not quite impeccable logic? We know that 36 inches = 1 yard. Therefore, 9 inches = ¼ of a yard. Since the square root of 9 is 3 and the square root of ¼ is ½, we conclude that 3 inches = ½ yard!13/ Not being able to conclusively refute the claims does not constitute evidence for them.14/ If you walk down the main street of a resort town any summer night, for example, and see happy people holding hands, eating ice-cream cones, laughing, etc., it's easy to begin to think that other people are happier, more loving, more productive than you are, and so become unnecessarily despondent. Yet it is precisely on such occasions that people display their good attributes, whereas they tend to hide and become 'invisible' when they are depressed. We should all remember that our impressions of others are usually filtered in this way and that our sampling of people and their moods are not random.15/ Any given individual, no matter how brilliant or rich or attractive he or she is going to have serious shortcomings. Excessive concern with oneself makes it difficult to see this and thus can lead to depression as well as innumeracy.16/ Bad things happen periodically, and they're going to happen to somebody. Why not?17/ Remember that rarity in itself leads to publicity, making rare events appear commonplace. Terrorist kidnappings and cyanide poisonings are given monumental coverage, with profiles of the distraught families, etc., yet the number of deaths due to smoking is roughly the equivalent of three fully loaded jumbo jets crashing each and every day of the year, more than 300,000 Americans annually. AIDS, as tragic as it is, pales in worldwide comparison to the more prosaic malaria, among other diseases. Alcohol abuse, which in this country is the direct cause of 80,000 to 100,000 deaths per year and a contributing factor in an additional 100,000 deaths, is by a variety of measures considerably more costly than drug abuse. It's not hard to think of other examples (famines and even genocides scandalously underreported), but it's necessary to remind ourselves of them periodically to keep our heads above the snow of media avalanches.18/ Very intelligent people can be expected to have intelligent offspring, but in general, the offspring will not be as intelligent as the parents. A similar tendency toward the average or mean holds for the children of very short parents, who are likely to be short, but not as short as their parents. If I throw twenty darts at a target and manage to hit the bulls-eye eighteen times, the next time I throw twenty darts, I probably won't do as well. This phenomenon leads to nonsense when people attribute the regression to the mean as due to some particular scientific law, rather than to the natural behavior of any random quantity. If a beginning pilot makes a very good landing, it's likely that his next one will not be as impressive. Likewise, if his landing is very bumpy, then, by chance alone, his next one will likely be better. Regression to the mean is a widespread phenomenon, with instances just about everywhere you look.19/ Judy is thirty-three, unmarried, and quite assertive. A magna cum laude graduate, she majored in political science in college and was deeply involved in campus social affairs, especially in anti-discrimination and anti-nuclear issues. Which statement is more probable? (a) Judy works as a bank teller. (b) Judy works as a bank teller and is active in the feminist movement. The answer, surprising to some, is that (a) is more probable than (b) since a single statement is always more probable than a conjunction of two statements. That I will get heads when I flip this coin is more probable than that I will get heads when I flip this coin and get a 6 when I roll that die.20/ We find that detail and vividness vary inversely with likelihood; the more vivid details there are to a story, the less likely the story is to be true.21/ Choose between a sure \$30,000 or an 80 percent chance of winning \$40,000 and a 20 percent chance of winning nothing. Most people will take the \$30,000 even though the average expected gain in the latter choice is \$32,000 (40,000 x .8). What if the choices are either a sure loss of \$30,000 or an 80 percent chance of losing \$40,000 and a 20 percent chance of losing nothing? Here most people will take the chance of losing \$40,000 in order to have a chance of avoiding any loss, even though the average expected loss in the latter choice is \$32,000 (40,000 x .8). Tversky and Kahneman concluded that people tend to avoid risk when seeking gains, but choose risk to avoid losses.22/ An item whose price has been increased by 50 percent and then reduced by 50 percent has had a net reduction in price of 25 percent. A dress whose price has been 'slashed' 40 percent and then another 40 percent has been reduced in price by 64 percent, not 80 percent. The new toothpaste which reduces cavities by 200 percent is presumably capable of removing all of one's cavities twice over, maybe once by filling them and once again by placing little bumps on the teeth where they used to be. The 200 percent figure, if it means anything at all, might indicate that the new toothpaste reduces cavities by, say 30 percent, compared to some standard toothpaste's reduction of cavities by 10 percent (the 30 percent reduction being a 200 percent increase of the 10 percent reduction). The latter phrasing, while less misleading, is also less impressive, which explains why it isn't used. The simple expedient of always asking oneself: 'Percentage of what?' is a good one to adopt. If profits are 12 percent, for example, is this 12 percent of costs, of sales, of last year's profits, or of what?23/ According to government figures released in 1980, women earn 59 percent of what men do. Though it's been quoted widely since then, the statistic isn't strong enough to support the burden placed on it. Without further detailed data not included in the study, it's not clear what conclusions are warranted. Does the figure mean that for exactly the same jobs that men perform, women earn 59 percent of the men's salaries? Does the figure take into account the increasing number of women in the workforce, and their age and experience? Does it take into account the relatively low-paying jobs many women have (clerical, teaching, nursing, etc.)? Does it take into account the fact that the husband's job generally determines where a married couple will live? Does it take into account the higher percentage of women working toward a short-term goal? The answer to all these questions is no. The bald figure released merely stated that the median income of full-time women workers was 59 percent of that for men.24/ If each of the ten items needed for the manufacture of something or other has risen 5 percent, the total price has risen just 5 percent, not 50 percent. As I mentioned, a misguided local weathercaster once reported that there was a 50 percent chance of rain on Saturday and a 50 percent chance on Sunday, and so, he concluded, 'it looks like a 100 percent chance of rain this weekend.' Another weathercaster announced that it was going to be twice as warm the next day since the temperature would rise from 25 to 50. ...more

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