

plained how one can study patients under a “no treatment” protocol without inducing a placebo response. They must know that they are in a trial, otherwise they could not be studied. How can they be prevented from hoping that what is happening to them will be of benefit? Presumably the investigators in these cases had made the common but erroneous presumption that “placebo” means “sugar pill”. I suggest that the small effect noted on pain perception may show that, so far as pain management is concerned, a dummy pill adds significantly to the placebo response consequent on the symbolic significance of participating in a clinical trial. Moreover, Brody (pp. 285–286) cites a meta-analysis done in 1994 that confirmed the reality of the placebo response, contrary to the Danish study.

⁷ Robert G. Jahn & Brenda J. Dunne. (1997). Science of the subjective. *Journal of Scientific Exploration*, 11, 201–224.

⁸ Imants Baruss. (2001). The art of science: science of the future in light of alterations of consciousness. *Journal of Scientific Exploration*, 15, 57–68.

Seeing Red: Redshifts, Cosmology and Academic Science by Halton Arp. Montreal: Aperion, 1998. iv +314 pp. Softcover, \$25.00. ISBN 0-9683689-0-5.

Don’t read this book! For if you should decide after reading this review to disregard this advice, you will need to prepare to have your universe turned upside down. Should you then make your way through this small-print, 306-page tour de force, you will very likely come away doubting what you thought you knew of the large-scale structure of the universe. The cosmological interpretation of redshift for quasars and active galaxy nuclei has been challenged often before, although never so successfully. But one seldom sees serious suggestions that even the redshift-distance relation for ordinary galaxies may be wrong, as you will see here. And as if the implied revolution in cosmology were not enough, your view of the professionalism of scientists and academics in general, and of astronomers in particular, will be another casualty of your reading.

One can consume this book to different degrees. For example, a short summary of the evidence and implications appears on pages 239–241. If the writing proves too technical in places, even with the aid of the extensive glossary, one can get the essence of the evidence by just scanning the plates (8 pages in color), figures, and captions that appear on almost every page. For example, it’s not difficult to look at the picture of the x-ray filaments in Markarian 205, featured on the book cover as well, and to grasp the deep implications of that image. For if a low-redshift Seyfert galaxy is physically connected to and interacting with two high-redshift quasars, one on either side, then redshift can be neither a distance nor a velocity indicator. And that single picture then disproves the Big Bang and most of mainstream cosmology in its present form.

Arp knows the extragalactic sky perhaps better than any other living astronomer. He builds his case against the customary interpretation of redshift

methodically. The earliest hints of problems with redshift came in 1911 with the discovery that the bright, blue stars in our own Milky Way galaxy have systematically higher redshifts than the rest of the stars by about 10 km/s. Later observations showed that the O-stars in clusters within our galaxy are redshifted with respect to the B-stars by another 10 km/s or so—something called the “K-effect” and still disputed because it has no accepted theoretical explanation. However, doubts about the validity of the data were undercut and the K-effect confirmed by more recent measures of the redshifts of supergiant stars in the two Magellanic Clouds, nearby companion galaxies of the Milky Way. These too are redshifted by about 30 km/s with respect to other stars in those small galaxies. Yet no one suspects that all supergiant stars in our galaxy or in our immediate neighbors are fleeing away symmetrically from our own location well out toward one edge of the Milky Way.

Companion galaxies in general seem to have net redshifts that exceed that of their parents. All eleven companion galaxies in the Local Group have redshifts with respect to their parent, the Andromeda galaxy in the center of the group. Likewise, all eleven companion galaxies of the neighboring M81 group have redshifts relative to M81. Yet, if these companions were orbiting their parent galaxy, roughly 50% of them ought to have been blueshifted. Although the evidence for companion redshifts is less definitive for more distant galaxy groups, it is still statistically significant. Excess redshifts over blueshifts for companion galaxies relative to their parents is apparently a verifiable feature of the local universe. And that means the redshift must have some cause other than velocity.

We begin to get some clues about what may be happening when Arp reminds us of basic facts about radio galaxies. These were discovered long ago to have giant, usually double, radio lobes to either side, presumably the result of explosions and ejections of material from the parent galaxy. Higher resolution radio telescopes have found filaments connecting these lobes to the central galaxy. And the ejected radio pairs are now known to correspond closely with x-ray pairs across the same galaxy.

That brings us to the keys to unlocking the whole puzzle—the quasars—because quasars also often correspond with x-ray sources. High and low redshift quasars are associated far more often than reasonable chance allows. These sometimes display interactions and connections and often form pairs across low-redshift objects, which unrelated objects would not do.

Working entirely from the observational data, Arp shows us that ejections from active galactic nuclei at speeds up to 10% of the speed of light lead to escape. But ejections at slower speeds may not, especially since all ejections apparently decelerate on the way out. Slower objects end up captured at about 400 kpc from their parent galaxy. But both captured and escaped quasars end up with quite small peculiar velocities. Moreover, the closest and therefore most recent ejections have the highest relative redshifts and the lowest intrinsic luminosities. This leads Arp to suggest that the redshift of matter is an inverse

function of the age of that matter. As much as one wishes to resist this conclusion, Arp shows case after case that conforms to it, many found well after this hypothesis was in print, each with odds of thousands to one against chance. Moreover, these apparently ejected quasars with redshifts ordered inversely with distance from their parent also tend to line up along the minor axis of the parent galaxy.

The generality of these startling conclusions is shown by repeated examples, such as the Arp/Hazard pair of similar triplet quasars, having discordant redshifts and a Seyfert galaxy between them. Many other good examples were discovered by mainstream astronomers. However, even when looking in depth at single examples, Arp makes a compelling case against coincidence. A survey of all bright quasars showed that these have a concentration around the Virgo cluster at the center of the Local Supercluster, despite having redshifts that should place them far out into the universe in that direction and make them unrelated to one another. The most conspicuous quasar in the sky is 3C273, one member of a pair of quasars almost exactly aligned across the brightest galaxy in the Virgo cluster center. A peculiar hydrogen cloud known to be in the Virgo cluster near the coordinates of 3C273 has a long, narrow shape pointing back toward the quasar, which itself has a jet pointing toward the hydrogen cloud. An x-ray radiation map (see Figure 5-16) also shows connections between the cluster to the quasar. Yet the quasar is supposed to be 54 times farther away than the cluster, according to its redshift. As Arp says, over 30 years ago, the field of astronomy took a gamble against odds of a million to one that this situation was an accident. The newer x-ray and hydrogen cloud evidence have confirmed that this was a bad gamble, although the field is not yet ready to accept its losses and move on.

Because redshift is not a good distance indicator, Arp points out that apparent brightness often is. Quasars near M49 appear relatively random on a sky map until just the brighter ones in a half-magnitude range are plotted. Then magically, there appears a line of quasars emerging from M49, with redshifts decreasing with distance, just as the observation-driven model predicts.

Whenever secondary distance indicators are available, they support this picture. In some cases, Faraday rotation caused by traversing a magnetized plasma can be measured for quasars. So the amount of such rotation ought to be a distance indicator. But it was then discovered that quasars with redshifts of about 2 had only 1/3 as much Faraday rotation as quasars with redshifts of about 1, when they ought to have had twice as much rotation. By contrast, this is in accord with Arp's model because the redshift $z = 2$ quasars are intrinsically fainter and therefore are generally seen only at closer distances than those with $z = 1$.

Arp concludes that quasars are initially faint, point-like objects of high redshift that transform into lower-redshift, compact objects surrounded by a fuzz as they evolve. These develop into small, high-surface-brightness galaxies with more material around them. Ultimately these mature into normal, quies-

cent galaxies.

In this new view of relationships among astrophysical objects, Seyfert galaxies and their close cousins, BL Lac objects, are short-lived evolutionary stages associated with quasar ejection from active galaxy nuclei. In effect, Seyferts are quasar factories. Strong quasar number counts are associated with a nearly complete sample of bright Seyferts, as compared with non-Seyfert control fields. Some of these associations have laughable explanations in mainstream journal articles. Quasar GC0248+430 is described as a “possibly microlensed quasar behind a tidal arm of a merging galaxy,” which just happens to be a Seyfert.

Indeed, quasars look to astronomers like small portions of active (Seyfert-like) galactic nuclei. Their pairing across such nuclei, their alignment with radio emission pairings, the correspondences of x-ray maps, and the data from optical emission lines all strongly support the ejection interpretation. If nature has not already provided enough hints, an apparent magnitude vs. redshift (Hubble) diagram shows that Seyfert galaxies have too much redshift at fainter magnitudes and do not follow the same relationship as normal galaxies. Indeed, the Hubble diagram for Seyferts trends toward that for quasars, which likewise do not show a normal Hubble relationship between brightness and redshift. One wonders how many different ways nature must repeat this message about redshift not corresponding to distance before it sinks in with the astronomers.

Other astrophysical objects are in accord with this message. Water maser emissions are also seen in pairs roughly aligned with quasars. X-ray filaments or jets emerge from Seyfert galaxies and end at quasars, often in pairs of similar redshift on opposite sides of the minor axis of the galaxy between. And high-luminosity spiral galaxies have excess redshifts compared to normal spirals, as judged by the Tully-Fisher method of judging distances from rotation rates (which is independent of redshift).

One might well wonder what galaxy clusters have to say about this, since these are clearly physically associated groupings of galaxies. The supporting evidence they provide is truly extensive. Classically, whole galaxy clusters obey a Hubble diagram relation between redshift and brightness, with a dispersion of just a few tenths of a magnitude. But 14 clusters north of Cen A have a much larger dispersion, with a maximum range of 4 magnitudes. Such clusters have no relationship of the type claimed for ordinary galaxies and call into question that the classical Hubble relationship can have the meaning usually attributed to it—that redshift indicates distance—for anything. We may simply have been fooled by both luminosity and redshift being functions of mass, which would lead to an apparent Hubble relationship despite no true distance dependence.

Some of the cluster examples are certainly head-turners. Abell clusters of galaxies with higher redshifts are distributed right down the spines of both the Virgo cluster and its Southern Hemisphere twin, the Fornax cluster. A com-

plete sample over a large region of the southern sky showed that the strongest x-ray cluster concentration had the two brightest galaxies (M83 and Cen A) at its center, despite much larger redshift for the x-ray clusters. In general, x-ray clusters appear more commonly with redshifts of about 0.06 than chance allows, which in Arp's interpretation marks them as young and intrinsically redshifted.

Supporting data includes cooling flow measures, which indicate that at least 100 solar masses per year are being lost from these clusters. This implies 100 billion solar masses in a billion years. Where are they going? The obvious possibilities can all be ruled out. BL Lac objects, at redshifts intermediate between quasars and cluster galaxies, are apparently progenitors of clusters of galaxies. Normal galaxies within certain redshift ranges tend to align on the sky in strings, with the lowest redshift galaxy near the center. For example, 13 of the 14 brightest Northern Hemisphere spiral galaxies in uncrowded fields fall on well-marked lines of galaxies that have concentrations of fainter, higher redshift galaxies. And there are anomalous faint, blue, often active galaxies that fill out clusters in the redshift range between 0.2 and 0.4. These apparently evolve into the higher luminosity, lower redshift objects seen at $0.02 < z < 0.2$. Finally, below redshifts of about 0.02 we find strings of galaxies aligned through the brightest nearby spiral galaxies, presumably representing the last evolutionary stage of protogalaxies before becoming the slightly higher redshift companions of the original ejecting galaxies. We are so accustomed to thinking of this sequence as a time evolution that it takes some effort to rethink the whole picture as a mass-luminosity-redshift evolution at a nearly fixed time.

So the young-appearing objects with the highest redshifts are aligned on either side of eruptive objects, which implies the ejection of protogalaxies and the association of redshift with youth. Increasing distance from parent leads to brighter, lower redshift objects, so this is the direction of evolution with age. At redshifts of about 0.3 and distances of about 400 kpc from the parent, quasars become very bright at optical wavelengths and in x-rays and evolve into BL Lac-type objects—a short-lived stage because there are few of them. Finally, these evolve into clusters of galaxies, which are seen to appear at comparable distances to the BL Lac objects, implying that clusters may originate from the breakup of BL Lac objects.

There is more. Tight multiple-quasars-image groupings were originally dismissed as observational errors until the gravitational lens theory was invoked. Then many more examples were quickly found. G2237+0305 was essentially a high-redshift quasar in the nucleus of a low-redshift galaxy. Lensing was the only way out for cosmologists. The four quasar images were all within one arc second of the galaxy nucleus. But Hoyle computed the probability of such a lensing event as two in a million. Moreover, instead of being arcs as lensing theory predicted, the quasar images are extended back toward the central galaxy. Real arc images don't look much like the predicted arcs either, but

rather like part of an expanded shell. This alternative is in better agreement with the existence of radial arcs, jet arcs, dog-leg arcs, and ejected jets that end in transverse arcs.

The last main observational area deals with the quantization of redshifts. In essence, redshifts do not take on all values with equal ease, as they must if they are caused mainly by the velocities of the observed objects. For example, redshifts near 0.061, 0.3, 0.6, 0.91, 1.41, and 1.96, etc., occur more frequently than chance permits. Smaller redshifts too occur at preferred periodic intervals, as Tifft has shown in a study confirmed in an independent sample by Guthrie and Napier. The existence of preferred values for redshifts proves that either we are at the center of a series of expanding shells, or redshift does not indicate velocity. Arp cautions that faint quasars with high redshifts do not continue to show this effect, perhaps because the form of the relationship changes at great distances from us (as faintness would suggest). Also, much of the spread that exists around these preferred redshift values is apparently due to the speed of ejection, which can be up to 0.1 c . The average redshift of a quasar pair generally falls closer to a preferred redshift value than does either individual redshift. BL Lac objects show the same quantization, but to a less pronounced degree, as befits their relationship to quasars. Figure 8-16 shows a striking set of bands and gaps for galaxy redshifts in the x-ray cluster Abell 85 that illustrates the redshift quantization effect at a glance.

Arp's strength is observational extragalactic astronomy. With theory he is less proficient, but he has enlisted the aid of Narlikar, Hoyle and others. The concept of mass increasing with age has no adjustable parameters (the characteristic age being given by the measured age of our own galaxy), yet it allows prediction of intrinsic redshifts for objects from K-effect stars to quasars, with results better than an order of magnitude. The Big Bang with many adjustable parameters cannot do as well. Redshift, then, indicates youth. And the slope of the Hubble diagram comes directly from our own galaxy's age. Since luminosity evolves with mass squared, the apparent brightness-redshift relationship is coincidental, and not an indicator of distance. I am no doubt biased here by seeing simpler theoretical explanations for Arp's observational constraints than his variable-mass theory can provide. But Arp concedes in places that theories need to evolve with discoveries, something that the Big Bang stopped doing at a fundamental level a generation ago.

Some of the most entertaining reading in this book is provided by Arp's interactions with his colleagues and with referees and journal editors. Arp spices up these exchanges with a bit of his own philosophy. Despite its pessimism, I wonder how any of us could have evolved a philosophy much more optimistic if we had been in Arp's shoes. Anonymous referees frequently use abusive language (such as "ludicrous") or unwarranted generalizations (such as "bizarre conclusions based on an extreme bias of the authors wishing to find non-cosmological redshifts"). It was not infrequent to find referees suggesting that the implications should have been used to prove the observations wrong! A Nobel

laureate and former teacher is quoted as saying “Arp did not get anything right in my course. I should have flunked him but I could not bear to have him repeat the course with me.”

We see in the anecdotes frequent occurrences of “sniping,” unbacked claims that something is true or false for some reason that is not presented to the author for rebuttal. One example: “Oh those claims have been completely disproved.” Arp introduces a few names for some of these battle tactics himself. The “Pleiades maneuver” is one such: Measure so much background that the statistical significance of the obvious foreground (such as the Pleiades cluster) is reduced to insignificance. Reaction to the x-ray map showing the connection of the Virgo cluster and quasar 3C273 produced five arrogant and patronizing referee rejections at two journals and were viewed even by some colleagues “like a grisly auto accident along the highway.”

Sadly, the mainstream is well adapted for survival. So when Arp succeeds in running the minefield and getting his results published despite the referees, an unwritten understanding is that no discussion or citations will follow, so the embarrassing result will soon be forgotten. Arp suggests that a sampling of referee reports, showing “manipulative, sly, insulting, arrogant, and above all *angry*” referees, ought to be published because it would allow people to evaluate the objectivity of the information they are being allowed to read.

Here are some brief quotes outlining what Arp has learned from these exchanges.

- “When presented with two possibilities, scientists tend to choose the wrong one.”
- “The stronger the evidence, the more attitudes harden.”
- “The game here is to lump all the previous observations into one ‘hypothesis’ and then claim there is no second, confirming observation.”
- “No matter how many times something has been observed, it cannot be believed until it has been observed again.”
- “If you take a highly intelligent person and give them the best possible, elite education, then you will most likely wind up with an academic who is completely impervious to reality.”
- “When looking at this picture no amount of advanced academic education can substitute for good judgment; in fact it would undoubtedly be an impediment.”
- “Local organizing committees give in to imperialistic pressures to keep rival research off programs.”
- “It is the primary responsibility of a scientist to face, and resolve, discrepant observations.”
- “Science is failing to self-correct. We must understand why in order to fix it.”

The book has many more like these.

As with any work of such length and depth, a few errors turned up along with a few points that are of dubious merit. None of us can be experts in everything, and we are always pushing the limits of our knowledge and training. Worth a comment are these points:

- Arp's arguments against tired light models (p. 97) make a common invalid assumption that quantum particles must be responsible for the energy loss. But there is good reason to suspect that quantum particles are by no means fundamental.
- Arp's proposal (p. 219) that even planetary and satellite masses may be quantized uses an invalid statistical argument when bridging large ranges of mass. But he may well be right for small mass differences. Origin in twin pairs by fission usually creates masses in the approximate ratio of 5 to 4, which may partly explain Arp's planet statistics. It might also explain his magical 1.23 redshift quantization ratio if a similar fission process is responsible for the twin ejections in galaxies.
- On p. 234, Arp cites the surface brightness test, which must vary as $(1 + z)^4$ in the Big Bang. He applies that to his own model on the assumption that observations support it. However, the observed dependence goes as $(1 + z)^2$. Evolution of galaxies is said to be responsible for the difference in the Big Bang, but that argument would not apply to Arp's model.
- On p. 237, Arp incorrectly states that the cosmic microwave radiation must come from a thin shell, saying that this has not been explained. But that radiation is supposed to have flooded the universe shortly after the Big Bang and been cooling ever since. So every point in the universe is today receiving cooled radiation, and there is no shell anywhere. Arp correctly goes on to provide more probable explanations for the radiation than a fireball residue.
- Arp's use of statistics cries out for him to explain the difference between *a priori* and *a posteriori* probabilities, if only to assure us that *he* understands the difference and its importance.
- It was disappointing to see no mention of the role of giant elliptical galaxies in the evolutionary scheme of things.

Arp correctly points out that one side in this meaning-of-redshift debate must be completely and catastrophically wrong. This leads him to wonder how many other uncertain assumptions might exist in other areas affecting our daily lives about which we are innocently overconfident. That is perhaps the most sobering thought of all.

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