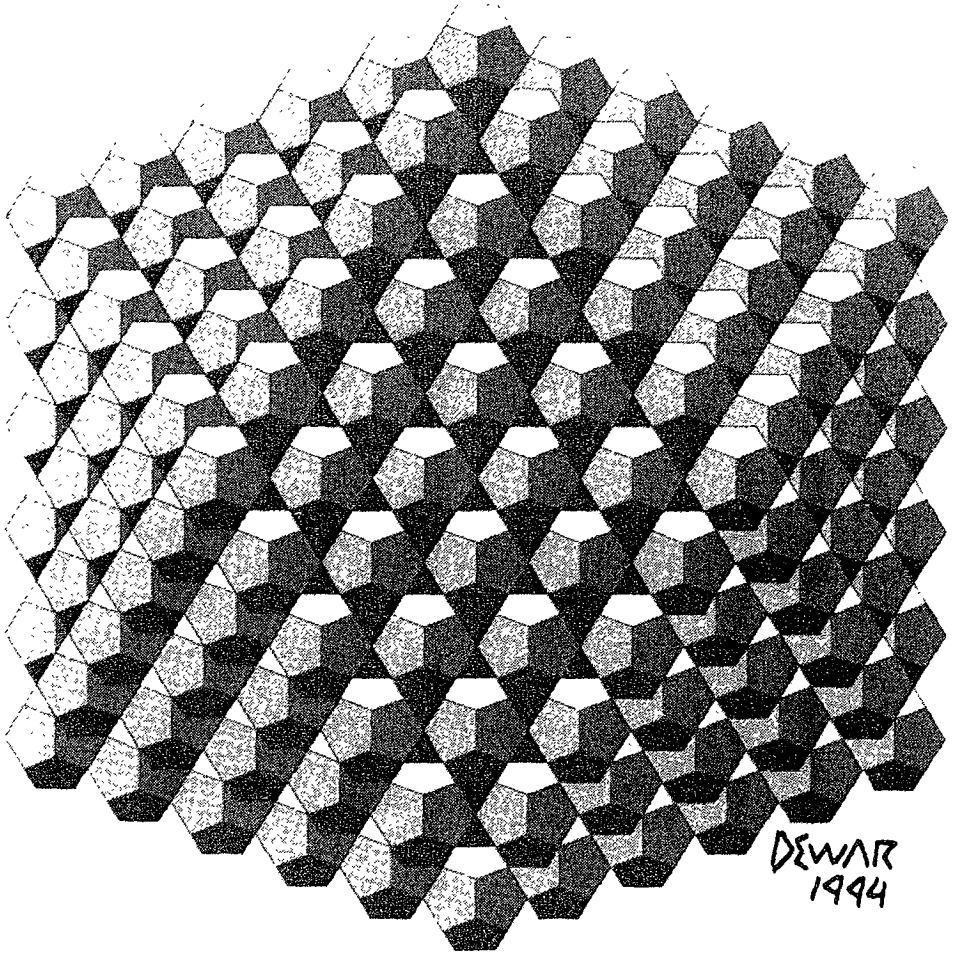
Symmetry: Culture and Science

Symmetry:
Natural and Artificial, 3

The Quarterly of the
International Society for the
Interdisciplinary Study of Symmetry
(ISIS-Symmetry)

Editors:
György Darvas and Dénes Nagy

Volume 6, Number 3, 1995



Third Interdisciplinary Symmetry Congress and Exhibition
Washington, D.C., U.S.A. August 14 - 20, 1995

SYMMETRY IMPLIES DISSYMMETRY

Joe Rosen
Department of Physics and Astronomy
University of Central Arkansas
Conway AR 72035, USA
E-mail: rosen@ccl.uca.edu

We deal with symmetry at its most fundamental and show that any symmetry, of whatever kind, must be accompanied by dissymmetry. Or in other words, without dissymmetry there can be *no* symmetry. We apply that to the Universe and show that perfect symmetry of the Universe is meaningless.

The essence of symmetry

The essence of symmetry is immunity to a possible change. We have symmetry when and only when it is possible to make a change under which some aspect of the situation remains unchanged. Then the situation can be said to be symmetric under the change with respect to that aspect. If you think of any kind of symmetry with which you are familiar, you will recognize that in essence it is just that, the immunity of some aspect of the situation to a possible change in some other aspect.

Note the two essential components of symmetry:

(a) *Possibility of change.* It must be possible to perform a change, although the change does not actually have to be performed.

(b) *Immunity.* Some aspect of the situation would remain unchanged, if the change were performed.

If a change is possible but some aspect of the situation is not immune to it, we have dissymmetry. Then the situation can be said to be dissymmetric under the change with respect to that aspect.

Although it is not directly relevant to our present discussion, I take this opportunity to mention that approximate symmetry is approximate immunity to a possible change. It must be possible to perform a change. The approximation is in the immunity. Approximate symmetry is a softening of the hard symmetry-dissymmetry dichotomy. The extent of deviation from exact symmetry that can still be considered approximate symmetry depends on the context and can be a matter of personal taste.

If there is no possibility of a change, then the very concepts of symmetry and dissymmetry are inapplicable. I propose calling such a situation *asymmetry*. That would ascribe a new meaning to the term *asymmetry*, which is commonly understood as synonymous with *dissymmetry*.

How change?

Change means that something different comes about. A reference is needed to give meaning to the difference and thus to the possibility of change. It is tautological that a changeable aspect of a situation is not immune to its change. A changeable aspect of a situation is such a reference. It allows the possibility of a change. So a situation will possess symmetry if and only if it has *both* an aspect that could change (giving the possibility of a change) *and* an aspect that would not change concomitantly (giving the immunity to the possible change). In other words, the possibility of a change, which is a necessary ingredient of symmetry, is contingent upon the existence of a dissymmetry of the situation under the change.

Symmetry of the Universe

An example: The laws of nature have been found to be the same wherever they have been investigated, and it seems to be consistent with observation to assume that the laws of nature are the same everywhere in the Universe. That is a symmetry of the Universe. The laws of nature we discover through our investigations are immune to the possible change of displacing our laboratory from here to there. Spatial displacement is indeed a change, because here and there are different from each other. Here might be on the surface of the Earth, while there might be inside a star. The inhomogeneous distribution of matter in the Universe serves as reference for spatial displacement. Thus the Universe possesses the symmetry that the laws of nature are immune to spatial displacement. Spatial displacement is a change thanks to the Universe's dissymmetry, that the distribution of matter in it is not the same everywhere, is not immune to spatial displacement.

Let us now imagine a hypothetical universe that might seem to be even more symmetric than the Universe actually is. Imagine a universe in which not only the laws of nature are the same everywhere, but so is the distribution of matter. Indeed, imagine a completely homogeneous universe, i.e., a universe possessing precisely the same properties at every point. Such a universe

might seem to be perfectly symmetric under spatial displacement in that *all* its aspects are immune to the possible change of spatial displacement. (That would be in contrast to the actual Universe, which is not perfectly symmetric under spatial displacement, but only with respect to the laws of nature.)

However, where is the reference for spatial displacement? What makes spatial displacement a change? Nothing at all! For such a universe there is no reference for spatial displacement, so spatial displacement is no change. Such a universe is not more symmetric under spatial displacement than is the real Universe. Indeed, spatial displacement symmetry is altogether meaningless for it. Hence neither is it dissymmetric. The very concepts of spatial displacement symmetry and dissymmetry are inapplicable to it. (We should say it is asymmetric.) That is because it does *not have* the possibility of spatial displacement. And that is because it possesses no reference for spatial displacement: there is no differentiation among locations in it; here is no different from there in any respect.

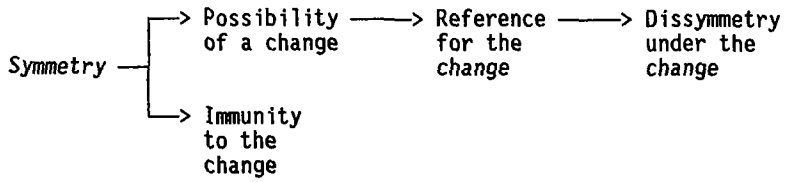
Another point I would like to mention in this connection, although it is not directly relevant to our discussion, is that since all locations in a hypothetical homogeneous universe are completely undifferentiated, all locations are identical and are actually one and the same location. Thus such a universe lacks spatiality altogether. (A homogeneous space as a *mathematical model* of the Universe is another matter altogether. There we conceptually impose spatial differentiation and a reference on it.)

The Universe is everything and an imagined universe is imagined to be everything. In contrast to any subsystem of the Universe, the Universe, or a universe, has no surroundings. Thus no external reference can be imposed on it. If the Universe, or a universe, does not contain a reference within itself, then such a reference is meaningless.

Thus for the Universe, or a universe, perfect symmetry is meaningless. Perfect symmetry of the Universe under some change would mean that the possibility of that change for the Universe is meaningful and that *all* aspects of the Universe are *immune to it*, i.e., that there is *no aspect of the* Universe that is not immune to the change. But then the Universe would possess no reference for the change. So the change would be meaningless for it, and there would be no symmetry, in contradiction to the premise. The above example of putative perfect spatial displacement symmetry of a universe shows how that works in a specific case.

Conclusions

Our results concerning symmetry, change, immunity, reference, and dissymmetry can be summarized by the following diagram, where arrows denote implication:



Thus for there to be symmetry, there must concomitantly be dissymmetry under the same change that is involved in the symmetry. For every symmetry there is a dissymmetry somewhere in the world.

So symmetry implies dissymmetry. This relation is not symmetric, since dissymmetry does not imply symmetry, at least not in the same sense that symmetry implies dissymmetry, that actual symmetry implies actual dissymmetry, as was demonstrated above. However, dissymmetry does imply symmetry in the limited sense that the lack of immunity to a possible change implies the conceptual possibility of immunity to that change. Thus actual dissymmetry implies merely the conceptual possibility of, not actual, symmetry.

From our result that symmetry under a change implies dissymmetry under the change, it follows that perfect symmetry of the Universe is a contradiction in terms. Perfect symmetry of the Universe would mean that all aspects of the Universe are immune to some change, that there is no aspect of the Universe that is not immune to the change, thus no dissymmetry under the change. That is a contradiction, since perfect symmetry of the Universe would not be fulfilling a necessary condition for it to be symmetry at all. The Universe would possess no reference for the change. So the change would not be possible for the Universe, and there would be no symmetry. Therefore, perfect symmetry the Universe is meaningless.