Scientists looking for life on other planets might propose a hypothesis: "all life requires water." In this paper I will examine such sentences by examining Carl Gustav Hempel's Raven paradox. Hempel asks us to consider the hypothesis "all ravens are black," by giving us three premises and a conclusion.

Hempel's first premise states that "all non-black things are non-ravens" is logically equivalent to "all ravens are black." By logically equivalent, we mean that both statements are true if and only if the other is true; the two sentences hold the same truth conditions. If it turns out that there are white-ravens, then both sentences are false. Conversely, if all ravens really are all black, then both sentences are true. Hempel's first premise is plausible because every conceivable universe in which the hypothesis is true, requires the logical equivalent sentence to be true too.

Hempel's second premise is Jean George Pierre Nicod's generalization, which says that when we propose a hypothesis like "All F's are G's", and we find an F that is a G, we have found support for the hypothesis. More concretely, when we say "all life requires water," we confirm the hypothesis by finding examples of organisms that require water.

Hempel's third premise is what inductive logicians call the equivalence condition. The condition says that evidence that supports a hypothesis also supports any and all logical equivalents. A logically equivalent statement for "all life requires water" is "either something is not-alive or it requires water." Thus, looking out a window and seeing an owl drinking water, supports the hypothesis "either something is not-alive or it requires water."

Putting these three premises together, Hempel demonstrates his paradox: given a hypothesis, like "all ravens are black," we have a logically equivalent hypothesis: "all non-black things are non-ravens." Then, since confirming one hypothesis confirms its logical equivalents, we must conclude that an observation of a non-black non-raven, like looking at a white shoe, confirms the hypothesis "all ravens are black." Thus, any time I look at something in the world that is a non-black non-raven, I am confirming a hypothesis about the color of corvids.

As we go about our day to day lives, we don't think we are making observations for the support of some hypothesis about ravens, which is why this conclusion is paradoxical. Hempel's response

to the paradox is to accept the conclusion, even if it is unintuitive. Many people find this response unsatisfactory, since seemingly mundane observations also provide support for absurd hypotheses, like "all ravens wear Air Jordans," since its logical equivalent is "all non-Air-Jordan-wearing things are non-ravens." Thus, the observation of a chair confirms the hypothesis, since it is a non-Air-Jordan-wearing non-raven.

Let us consider two solutions to the paradox. The first proposal comes British mathematician I.J. Good who noted that observations of non-black non-ravens may or may not support a hypothesis; Good rejects Nicod's criterion by asking us to consider what we already know; what is our background knowledge. Biologists understand that feather color is subject to variation and is largely if not entirely determined by a bird's genes. Thus, because biologists are aware of albinism, gene mutation, and variation in feather color among populations of corvids, such a hypothesis is not accepted or rejected based on how many observations of black ravens we make; the hypothesis is an artificial one, whose veracity does not tell us anything interesting about how scientists' hypotheses are confirmed in the real world.

Another solution to the paradox is the Bayesian approach, which accepts Hempel's conclusion but asks us to consider the dimension of probability. This approach says that the observation of a non-black non-raven supports our hypothesis only slightly. To see why this approach is intuitive, imagine a smaller problem: we propose that "all ravens in a sack are black." In the sack we have several objects, two of which are ravens.

We begin pulling objects out of the sack supposing that there is a small chance that our hypothesis is correct. If we pull out a black raven, then it seems as though the probability that the hypothesis is correct increases significantly, since only a single raven in the sack can disprove our hypothesis. If, however, we pull out a white shoe, then we have decreased the number of objects left to look at. The probability that our hypothesis is correct has only increased slightly. Thus, we can accept Hempel's conclusion without giving up our intuition that the observation of a black raven is more significant that the observation of a non-black non-raven.