cake are swimming, and cold applied so as to cause it to freeze, a drop remains unfrozen around each of these little animated forms for a certain time after the rest has congealed. Heat is being produced by the animal—to liberate that heat it must be consuming air and burning its body.

Again, in an instance with which many of us are familiar, the respiration of a small animal is shown. If on a cold day you watch a fly that has lighted on a dry window, a collection of moisture, the results of his respiration, will soon be seen in his neighborhood. It is the analogue of the larger condensation of vapor that would be produced were one of us to breathe on the same window. The fly is burning away and vaporizing water with the superfluous heat.

To illustrate the necessity of air to the well-being of animals, a bird may be put under a glass bell jar standing on the air-pump. By the aid of the pump the air can be removed to a large extent from the bell jar, and as soon as the exhaustion is commenced, the bird shows signs of discomfort and becomes more and more restless as the action continues. He would eventually die if kept under the exhausted jar.

To plants air is just as necessary as to animals, although we can not easily demonstrate this by a lecture-table experiment. The larger part of their substance is derived from the atmosphere by the aid of the Sun's beams; but a small portion comes in through the roots. Nature has so arranged the relations of plants to animals that they take out from the air the impurities that have been imparted to it by animals and replace the ingredients that are necessary to the latter If in any planet we could detect the traces of vegetable life, it would at once be a strong argument for the existence of animals there, and *vice versâ*.

But you may think that I have omitted the case of aquatic animals and water plants altogether. They seem to have no access to air, and might be fairly supposed not to require it. You will sustain yourselves in that opinion by citing the case of a man submerged in water who drowns, and by that of a fish brought out into the air that dies. Nevertheless air is necessary to all fishes; for if you boil water and so expel the air from it, and then when cool put a fish into it, he can not live. He is in the same condition as the bird in the bell jar.

The other case, that of a fish dying in the air, is as readily explained. A fish is not provided with lungs as we are, but breathes the air dissolved in water by the aid of its gills. When taken out of water the gills dry up, and the little tufts of blood vessels, of which they consist, adhere to one another so as to be unable to act any longer. Some fish, as the eel, have, however, the means of keeping their gills wet by causing the mouth to remain partly filled with water, and these can be retained on land for many hours and yet live.

Water in its turn is just as essential as air. By its aid food is carried into the body and distributed, and it also acts as a regulator of heat. If we tend to become too warm, as in the summer season, water escapes rapidly from the lungs and skin, and by its evaporation keeps us cool. That such evaporating processes cause a cooling may be proved by an experiment with which many of us are acquainted. It is often desired, when in the woods, to ascertain the direction from which the wind is blowing. We may need it as a guide. There may not be sufficient air stirring to drift away a light object like a straw. Under these circumstances foresters, having wetted the finger, hold it upward at arm's length. A gentle breeze causes the moisture to evaporate more rapidly on the side it first strikes, and the direction is at once indicated by the coldness of that side. So also in the case of the porous earthen-ware vessels used in southern climates for keeping water cool. The fluid that soaks through the earthen-ware, evaporating from the outside, keeps the temperature of the water much below that of the surrounding air.

Lastly, as regards food, but little requires to be said. All know from hard experience how necessary it is. If we do not eat we soon become emaciated and die after a short interval. What is the cause of this wasting away, and why can we not resist it by the will? We have already learned that air is essential to our well-being, because we must have a burning continually going on in the body. But we must also have a fuel to burn, and this fuel is either the food or portions of the body that have been made out of it. If we do not eat and resupply the parts that are consumed, our weight becomes daily less and less, as we see in wasting fevers, until, when a certain point is attained, we die of cold.

The food we require is produced by plants, the remark applying even to meat, which has been extracted from plants by oxen, sheep, etc. That it is combustible can be proved by experiment. A piece of meat or bread, if placed in the fire, burns away, leaving only a little ash; the mass of it having united with oxygen and disappeared in a gaseous form. The same would have happened had it been eaten, though the burning would have been slower and without flame.

It is the combustibility of stimulants, such as whisky and brandy, that renders them valuable in low fevers. Now-a-days the treatment in such cases is to give the patient as much liquor as he can bear without becoming intoxicated; it burns away within him to produce the animal heat he requires, and so saves him to a certain extent from the emaciation that would be produced by the burning of his body. For the healthful performance of the functions of the system a temperature of nearly 100 degrees must be maintained by man; if he becomes much cooler than this he will die of cold. The sensation of cold piercing to the very marrow of the bones, so keenly felt by those ascending high mountains, is due to the attenuated state of the air in such localities, not enough can be taken in by the lungs at each breath to keep the body burning at a proper rate.

We are now ready to glance for a few moments at the construction of the solar system. Around the Sun, a sphere 880,000 miles in diameter, there revolve a number of globes; some, the more important, called planets; some the moons or satellites of these planets; and the rest asteroids, or else, if very small, aerolites or meteors. The planets are, of course, the bodies most likely to prove interesting to us, and they may therefore be profitably enumerated. The nearest to the Sun is Mercury, 37 millions of miles distant; next comes Venus, 68 millions of miles distant; then the Earth, 95 millions of miles. Outside of us, or farther from the Sun, are Mars, 112 millions of miles from that luminary; Jupiter, 485 millions; Saturn, 900 millions; Uranus, 1800 millions; and Neptune, 3000 millions.

An idea of the comparative size of these bodies and their distances from the Sun may be gained from a table constructed by Sir John Herschel:

The *Sun*, a globe two feet in diameter.
Mercury, a mustard seed, diameter of orbit 164 feet.
Venus, a pea, diameter of orbit 284 feet
The Earth, a larger pea, diameter of orbit 430 feet.
Mars, a large pin's head, diameter of orbit 654 feet.
Jupiter, an orange, diameter of orbit half a mile.
Saturn, a small orange, diameter of orbit one and one-fifth mile.
Uranus, a cherry, diameter of orbit a mile and a half.
Neptune, a plum, diameter of orbit two and a half miles.
The nearest Fixed Star, distance fifteen thousand miles.

If we can succeed in rendering it probable that on any of these bodies there is life, we shall be led at once to extend the sphere of animated nature infinitely. For we know that each of the countless multitudes of fixed stars, which delight our gaze on a clear evening, is a sun, shining, as our sun does, by virtue of its own light. At distances vastly greater than these are collections of stars, which, though they may in reality be separated as far from one another as the nearest fixed star is from us, yet seem to be closely packed together These, the resolvable nebulæ, are stellar systems of prodigious extent. Many are not bright enough to affect the naked eye; and who shall say what immense numbers there may be invisible even with the telescope?

We may argue from analogy that all these suns, many of them larger than ours, are surrounded by trains of planets, revolving around them at various distances. If on any of the planets of our solar system life can be maintained, why not on those planets too? and does it not seem reasonable to suppose that all those bodies have been created for some other purpose than merely occasionally to illuminate our skies? Is this little speck in the universe where we are existing, and which is visible to only two or three of its immediate neighbors, the only seat of life?

"Each of these stars is a religious house;
I saw their altars smoke, their incense rise,
And heard hosannas ring through every sphere.
The great proprietor's all-bounteous hand
Leaves nothing waste, but sows these fiery fields
With seeds of reason, which to virtue rise
Beneath his genial ray."

But you may say, How do you know that those other worlds are not composed of such material that life is there impossible? Science has within the last few years stretched her hand across the almost immeasurable distances which separate us from the fixed stars, and told us that there are in them many of the substances with which we are here familiar. It would lead us too far from our subject to indicate the manner in which so grand a result has been reached. I can only tell you that we are able, by examining the light coming from the stars by a prism, to detect their composition, just as if we had fragments of them in our laboratories. Spectrum analysis has made the chemist's arms millions of millions of miles long.

Let us examine our planetary neighbors, and ascertain what are the chances of inhabitation upon them. The two planets that are nearer to the Sun than the Earth may be dismissed at once. The