electric filters we have made many other experiments to find other means for the dis-electrification of air. It might be supposed that drawing air in bubbles through water should be very effective for this purpose, but we find that this is far from being the case. We had previously found that non-electrified air drawn in bubbles through pure water becomes negatively electrified, and through salt water positively. We now find that positively electrified air drawn through pure water, and negatively electrified air through salt water, has its electrification diminished but not annulled, if the primitive electrification is sufficiently strong. Negatively electrified air drawn in bubbles through pure water, or positively electrified air drawn through salt water, has its electrification augmented.

§ 11. To test the effects of heat we drew air through combustion tubes of German glass about 180 cms. long, and $2\frac{1}{2}$ or $1\frac{1}{2}$ cms. bore, the heat being applied externally to about 120 cms. of the length. We found that, when the temperature was raised to nearly a dull red heat, air, whether positively or negatively electrified, lost little or nothing of its electrification by being drawn through the tube. When the temperature was raised to a dull red heat, and to a bright red, high enough to soften the glass, losses up to as much as four-fifths of the whole electrification were sometimes observed, but never complete diselectrification. The results, however, were very irregular. Non-electrified air never became sensibly electrified by being drawn through the hot glass tubes in our experiments, but it gained strong positive electrification when pieces of copper foil, and negative electrification when pieces of carbon, were placed in the tube, and when the temperature was sufficient to powerfully oxidize the copper or to burn away the charcoal.

§ 12. Through the kindness of Mr. E. Matthey, we have been able to experiment with a platinum tube 1 metre long and 1 millimetre bore. It was heated either by a gas flame or an electric current. When the tube was cold, and non-electrified air drawn through it, we found no signs of electrification by our receiver and electrometer. But when the tube was made red or white hot, either by gas burners applied externally or by an electric current through the metal of the tube, the previously non-electrified air drawn through it was found to be electrified strongly positive. To get complete command of the temperature we passed a measured electric current through 20 centimetres of the platinum tube. On increasing the current till the tube began to be at a scarcely visible dull red heat we found but little electrification of the air. When the tube was a little warmer, so as to be quite visibly red hot, large electrification became manifest. Thus 60 strokes of the air pump gave 45 scale divisions on the electrometer when the tube was dull red, and 395 scale divisions (7 volts) when it was a bright red (produced by a current of 36 ampères). With stronger currents, raising the tube to white-hot temperature, the electrification seemed to be considerbly less.

SCIENCE OR POETRY.

THE hardest of intellectual virtues is philosophic doubt, and the mental vice to which we are most prone is our tendency to assume that lack of evidence for an opinion is a reason for believing something else.

This tendency has value in practical matters which call for action, but the man of science need neither starve nor choose, and suspended judgment is the greatest triumph of intellectual discipline, although vacillation brands the man of affairs with weakness.

Anything which is conceivable may be

good poetry, but science is founded upon the rock of evidence, and we all believe many things which are inconceivable, such as the truth that the image in our eyes is upside down, and we justly repudiate many opinions which are not only quite conceivable but also quite incapable of disproof.

Many persons have found the opinion that all nature is conscious and endowed with volition, that the morning stars sing together, that the waters laugh, that the wind bloweth where it listeth, and that trees talk; not only conceivable but worthy of belief, and it is quite clear that we cannot oppose any belief of this sort, or convert the sailor who believes the wind obeys his whistle, by evidence.

The path of scientific progress is strewn with beliefs which have been abandoned from lack of evidence, as burst shells strew a battlefield, and it is our boast that they are abandoned and not lugged along the line of march.

As a shell which has failed to burst is now and then picked up on some old battlefield by some one on whom experience is thrown away, and is exploded by him with disastrous results in the bosom of his approving family, so one of these abandoned beliefs is sometimes dug up by the head of some scientific family to the intellectual confusion of those who accept him as their leader.

We need not concern ourselves with the beliefs of the unscientific, but the utterances of the heads of learned societies are public acts, approved by the majority of the members. They come before the public with authority, and they are regarded by the world as the expressions of the mature judgment of American men of science.

In a recent number of Science (p. 210) a 'President' quotes the opinion 'of a chemist, a physicist and a biologist,' to the effect that they cannot conceive how the problems of biology are to be referred to mechanical energy and physical matter; and he tells us furthermore that "it can be stated without fear of refutation that every physiological investigation shows with accumulating emphasis that the manifestations of living matter are not explicable only with the forces of dead matter."

The assertion that this is shown by every or by any physiological investigation is flatly contradicted by most of the investigators; but the assertion that *it can be stated without fear of refutation that so and so is true* is a pretty safe one, although a moment's reflection will show that there is no end to the things which may be stated without fear of refutation; that Mars is inhabited, for example, or that we are surrounded by good and evil spirits.

Another recent number of Science (p. 125) contains the statement, by one who is many times a President, that when protozoa move towards the light they 'seek' oxygen, and that in order to 'seek' it "they have to be aware that they need it, and must have some knowledge of the fact when they get it."

When we ask how the President knows all this we receive this most remarkable and characteristic answer: "It is impossible at present *to assign any other cause* to some of the movements of even the amœba."

A child can see that lack of proof is not evidence, and while it is impossible to prove that an amœba or an oak tree is not conscious and is not endowed with volition, the statement that they are so endowed is not science but poetry until some better evidence than lack of proof is adduced.

Even if positive evidence were found, even if it were proved that all nature is conscious, this would not be proof that consciousness and volition are or can be causes of structure.

If we admit, as I think we must, that, for all we know, an oak tree may have volition and may do as it likes, what evidence

is there that it ever likes to do anything which it would not do in any case, by virtue of its structure, even if it were unconscious?

If the President will give us evidence that volition is an agent in this sense of the word; that it can do anything which is not deducible from structure; that it can be a cause of structure; that any one by taking thought can add one cubit to his stature, I, for one, will hold him in the highest honor as the greatest of discoverers; nor do I believe that he will find me prejudiced, for I trust that I have done all that in me lies to refrain from preconception, and I simply want to know.

"If he possesses such knowledge he is just the man for whom I have long been seeking. All knowledge can be communicated, and therefore I might hope to see my own knowledge increased to this prodigious amount by his instruction." (Kant; translated by Huxley; *Hume*, p. 208.)

If the learned bodies which give their allegiance to the utterances I have quoted will publish the evidence which proves that consciousness and volition can cause structure or anything else, they will not only demonstrate their own scientific eminence, but, by settling a question which has never ceased to vex the mind of man, they will make the closing years of the nineteenth century memorable for all time by the greatest scientific discovery the world has seen.

In an article which was printed in SCIENCE in April, 1895, I urged the need for philosophic doubt on the problems of life, and I also took occassion to affirm my own opinion that the phenomena of vitality and of volition are so peculiar that these words are most useful ones in so much as they help to focus the most distinctive problems of biology.

I thought I had made it clear that my plea for these words is based on their value in helping us to keep difficulties in clear view and not because they explain anything; and I have been much surprised by the receipt of a number of letters from Vitalists who welcome me as a new recruit.

No one likes to march alone; and both sides put the man who does not take sides with the enemy. We need all the comrades we can get in our weary way through life, and I regret the necessity which forces me to tell my correspondents I cannot fight under their banner; and that my only purpose in writing the article was to show that intolerance has followed the conversion into a belief, by pious Monists, of Huxley's carefully guarded declaration that he lives '*in the hope and in the faith*' that we shall some time be able to see our way from the constituents of living matter to its properties.

Nothing was farther from my thoughts than any dogmatic assertion that vitality and volition are outside the domain of physical matter and mechanical energy, or that they are agents, and I had in mind certain zoölogists who seem to me to be attempting to discount the possibilities of future discovery in defiance of the warning "that the assertion which outstrips evidence is not only a blunder but a crime."

Recent utterances seem to show that all the criminals are not among the materialists, and that the dogmatism of biologists must be attacked at both ends of the line.

In all seriousness we ask, what can fundamental disagreement among those who speak with authority lead to, except disaster? Are we not bound to find first principles which will command the assent of all thinking men?

Those who hold the creed that all the activities of animals and plants will some day be deduced from the properties of the physical basis of life are not likely to be influenced by any other opinion of the matter, whether this be called a belief, a hope or a working hypothesis; nor are those who hold that our will is free at all persuaded by those

who assert that volition is only an empty shadow of the changes which go on in the physical basis. So far as I can see, there can be no compromise between these opinions; and the *modus vivendi* is a device of the men of affairs, with which science has no concern.

Science still has many acute and well-trained enemies, and if they should concentrate their forces in an attack upon biology what better weapon could we place in their hands than our own failure to agree?

Honesty of purpose and expediency unite in the demand that we build biology upon a foundation which can never be shaken; and if we accept as our creed the assertion that while we do not know whether life is or is not different from matter, that while we do not know whether thought is or is not an agent, we should like to find out, we need fear no attack by anything in the universe or outside it.

I am tempted to add a word of comment on one of my letters, as it bears upon the case in point, and is a good illustration of a belief which is held because it cannot be disproved.

It is accompanied by a book in which the writer devotes literary training and skill which many a scientific writer might envy, and eloquence and enthusiasm worthy of any cause, to the thesis that the living world is the work of 'Biologos;' a being who is said to bear about the same relation to us as that which we bear to the plants which we cherish in our gardens from love of horticulture; a being who is very paternal, very loving, very sympathetic and very superhuman, but still very far short of omnipotence or omniscience.

The writer seems to forget that there is no new thing under the sun, and that ages ago the first of naturalists failed to secure appointment as successor to the head of a school where very similar views had been taught, on account of his refusal to advocate them, not because he thought he could disprove them, but because he held that they are not supported by evidence.

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*BIBLIOGRAPHY AS A FEATURE OF THE CHEMICAL CURRICULUM.**

When the Chairman of the Committee on Didactic Chemistry sent me a flattering invitation to address the Chemical Section on some topic associating bibliography with instruction, I hesitated to accept, for it seemed to me that the matter was too obvious to require discussion; but later, as chairman of a committee whose duty it is to encourage, in every possible way and on all occasions, the indexing of chemical literature, I concluded it was my duty to seize the opportunity of saying a few words in favor of introducing bibliographical research into the chemical curriculum of our American colleges. Could this be generally done what a multitude of chemical indexes to special topics might be secured!

The matter is largely in the hands of the heads of the chemical departments in our institutions of learning. As in every branch of instruction, in order to impart to students a lively interest in the subject, the teacher should himself have practical experience in the approved methods of indexing. He might introduce the subject by a lecture on Chemical Literature, pointing out the most recent and the most useful books and serials in the several branches of the science, their special and relative values, and the best way to use them. The teacher might exhibit a sample index in MS., prepared on the index cards of the Library Bureau, and he might explain to those unfamiliar with library cataloguing the technical methods employed. He might also discuss the different ways of

*Read to the Chemical Section of the American Association for the Advancement of Science, Springfield Meeting, August, 1895.