SCIENCE:

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PROFESSOR TAIT, in a recent number of *Nature* (Nov. 25, 1880), directs attention to the necessity of perfect definiteness of language in all scientific work. "Want of definiteness," he says, "may arise from habitual laziness, but oftener indicates a desire to appear to know, where knowledge is not."

It is also claimed that scientific writers, even of the present day, have not that clear comprehension, which is essential, of what is subjective and that which is objective, and thus much confusion arises. To use Professor Tait's own language, our only source of information in physical science is the evidence of our senses. To interpret truly this evidence, which is always imperfect and often wholly misleading, is one of the tasks set before reason. It is only by the aid of reason that we can distinguish between what is physically objective and what is merely subjective. Outside us there is no such thing as noise or brightness; these no more exist in the aerial and ethereal motions, which are their objective cause, than does pain in the projectile which experience has taught us to avoid. To arrive at the objective point of Professor Tait's article, we may state that it involves a disagreement between himself and Mr. Herbert Spencer, as to the real meaning of certain words, and the propriety of making use of them on occasions which are mentioned.

In one of his works, Mr. Spencer states that, "Evolution is a change from an indefinite, incoherent homogeneity, to a definite heterogeneity, through continuous differentiations and integrations."

Mr. Kirkman translates the foregoing into "plain English," or as Professor Tait rather profanely asserts, "strips it of the tinsel of high flown and unintelligible language," thus:

"Evolution is a change from a nohowish, untalkaboutable, all-alikeness, to a somehowish and ingeneral talkaboutable not-all-alikeness, by continuous somethingelsifications and sticktogetherations."

Mr. Spencer claims that the explanation of the meaning of the word "Evolution" is a formula. Professor Tait calls this "a definition;" hence the difference of opinion, the latter asserting it to be not a mere quibble of words, but that an important scientific distinction is involved, to which the attention of the scientific world is directed.

The perusal of a communication from Professor Asaph Hall, of Washington, which will be found in this column, will greatly assist those who desire to solve the question. Professor Hall does not enter into any details of the controversy, but offers "*an illustration*" which appears to strike at the root of the matter in dispute.

We think that Mr. Spencer may rest satisfied with applying the term "*definition*" to his form of words, for by the rule presented by Professor Hall, it is evidently straining a point to assert that in them we find "a *formula*," using that word in the same sense as when we speak of the law of gravitation.

By the law of gravitation astronomers are able to predict the positions of known celestial bodies four years before the event, and Professor Tait asks if Mr. Spencer, with his "formula," can predict, four years before hand, the political and social changes which will happen in the history of Europe.

AN ILLUSTRATION.

In regard to the controversy between Professor Tait and Mr. Herbert Spencer, I beg to offer the following illustration. If we take by chance the three numbers 11, 12, 13, and form their squares, we have

$$(11)^2 = 121$$
$$(12)^2 = 144$$
$$(13)^2 = 169$$

Now take the numbers with the figures in an inverted order, and we have,

$$(11)^2 = 121$$
$$(21)^2 = 441$$
$$(31)^2 = 961$$

We see that the figures of the squares are also inverted; and this holds in the case of three consecutive numbers. We infer therefore that this is a general law in the formation of square numbers. Arguments of this kind might have an extended application in various branches of science; but if we make further examination we soon find numerous exceptions to our

law, and we conclude finally that, although in the common phrase there may be something in it, yet our assumed law is in fact no law at all.

Again I examine my table of squares, and I find a rule of this kind: The second differences of the squares are constant, and equal to 2. I make many trials of this rule and never find an exception. Others do the same and always the same result is found. We conclude therefore that we have at length discovered a real law that exists in the formation of squares; but at the same time we invite every one to make the examination for himself, and if possible to find an exception.

A. HALL.

Washington, D. C., December 17, 1880.

PROFESSOR TAIT AND MR. HERBERT SPENCER.

In another column we have referred to the controversy between Professor Tait and Mr. Spencer. Since this was put in form we have received a copy of Mr. Spencer's reply and, with pleasure, give his own explanation, which appears in *Nature* of the 2d instant:

"I pass now to his implied judgment on the formula, or definition, of Evolution. And here I have first to ask him some questions. He says that because he has used the word 'definition' instead of 'formula,' he has incurred my 'sore displeasure and grave censure.' In what place have I expressed or implied displeasure or censure in relation to this substitution of terms? Alleging that I have an obvious motive for calling it a 'formula,' he says I am 'indignant at its being called a *definition*.' I wish to see the words in which I have expressed my indignation; and shall be glad if Prof. Tait will quote them. He says—'It seems I should have called him the *discoverer of the formula!*' instead of 'the inventor of the definition. Will he oblige me by pointing out where I have used either the one phrase or the other? These assertions of Prof. Tait are to me utterly incomprehensible. I have nowhere either said or implied any of the things which he here specifies. So far am I from consciously preferring one of these words to the other, that, until I read this passage in Prof. Tait's lecture, I did not even know that I was in the habit of saying 'formula' rather than 'definition.' The whole of these statements are fictions, pure and absolute.

"My intentional use of the one word rather than the other, is alleged by him *àpropos* of an incidental comparison I have made. To a critic who had said that the formula or definition of Evolution 'seems at best rather the blank form for a universe than anything corresponding to the actual world about us,' I had replied that it might similarly be 'remarked that the formula—"bodies attract one another directly as their masses and inversely as the squares of their distances," was at best but a blank form for solar systems and sidereal clusters. Whereupon Prof. Tait assumes that I put the 'Formula of Evolution alongside of the Law of Gravitation,' in respect to the definiteness of the provisions they severally enable us to make; and he proceeds to twit me with inability to predict what will be the condition of Europe four years hence, as astronomers 'predict the positions of known celestial bodies four years beforehand.' Here we have another example of Prof. Tait's peculiarity of thought. Because two abstract generalizations are compared as both being utterly unlike the groups of concrete facts interpreted by them, *therefore* they are compared in respect to their other characters.

"But now I am not unwilling to deal with the contrast Prof. Tait draws; and am prepared to show that when the conditions are analogous, the contrast disappears. It seems strange that I should have to point out to a scientific man in his position, that an alleged law may be perfectly true, and that yet, where the elements of a problem to be dealt with under it are numerous, no specific deduction can be drawn. Does not Prof. Tait from time to time teach his students that in proportion as the number of factors concerned in the production of any phenomenon becomes great, and also in proportion as those factors admit of less exact measurement, any prediction made concerning the phenomenon becomes less definite; and that where the factors are multitudinous and not measurable, nothing but some general result can be foreseen, and often not even that? Prof. Tait ignores the fact that the positions of planets and satellites admit of definite prevision, only because the forces which appreciably affect them are few; and he ignores the fact that where further such forces, not easily measured, come into play, the previsions are imperfect and often wholly wrong, as in the case of comets; and he ignores the fact that where the number of bodies, affecting one another by mutual gravitation, is great, no definite prevision of their positions is possible. If Prof. Tait were living in one of the globular star-clusters, does he think that after observations duly taken, calculations based on the law of gravitation would enable him to predict the positions of the component stars four years hence? By an intelligence immeasurably transcending the human, with a mathematics to match, such prevision would doubtless be possible; but considered from the human standpoint, the law of gravitation, even when uncomplicated by other laws, can yield under such conditions only general and not special results. And if Prof. Tait will deign to look into 'First Principles,' which he apparently prides himself on not having done, he will there find a sufficient number of illustrations showing that not only other orders of changes, but even social changes, are predictable in respect to their general, if not in respect to their special characters."

REVERSION IN FLORAL PARTS.

By WILLIAM A. BUCKHOUT.

One of the best plants for showing the reversion of floral parts to the form of leaves is the common red field-clover (*Trifolium pratense.*)

It is always easily obtained, and during the fall of the year these heads of reverted flowers are quite common. The pedicels of the flowers are much elongated, and somewhat reduced in number; hence the heads have a loose appearance, which, with their very leafy look and absence of color, makes them conspicuous among

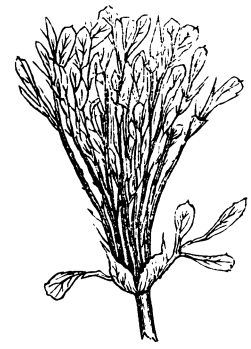

FIG. 1.

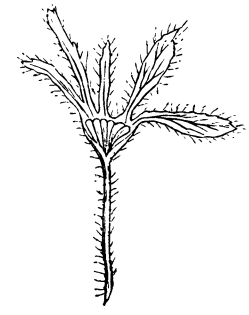

FIG. 2.

those having well developed flowers. Fig. 1 gives at fair idea of one of these heads. A dissection of a