

Fah.). Gases, on account of their expansibility must be raised to a far higher temperature; consequently the point of visibility is seldom reached, unless the gas itself is combustible, i.e., capable of producing by combination with the oxygen of the air the requisite degree of heat. One of the essential conditions of flame, then, is the presence of a combustible vapour, as gas, or of a liquid or solid, capable of being converted by the heat of the combustion into a combustible gas or vapour, as alcohol, oil, fats, candles, etc. A diamond, or a piece of dense, thoroughly carbonized charcoal, will burn away in oxygen with great intensity, but with a steady glow and no flame, because the carbon is not capable of being converted into vapour, while sulphur burns with a bright, large flame, because the heat converts it into vapour before the combination takes place.

A gaseous matter is essential to flame, so solid particles, suspended in the flame and brought to a white heat, are essential to its luminosity. The flame of hydrogen is the hottest known, but it is all but invisible, from the absence of solid matter. It may, however, be made visible by blowing very fine powder through it.

When sulphur is burnt in oxygen, it does so with a pale violet light. Phosphorus so treated gives forth dense white fumes of the most intense brilliancy; the reason of these phenomena being, that sulphur, in combining with oxygen does so to form sulphurous anhydride, SO_2 , which is gaseous at this temperature; while the phosphorous under like circumstances, forms phosphoric anhydride, P_2O_5 , which remains for a short time in the solid form, and being suspended in the flame in a very minute state of sub-division, becomes heated to so high a temperature as to emit a beautiful white light.

The brightness or illuminating power of a flame depends mainly on three things:—

(1) *On the temperature of the gases which are combining together to produce the flame.* P. burns in Cl. with a very feeble light, but if the Cl. and P. vapour be both heated the combustion takes place with a dazzling white light.

(2) *On the density of gases.* Dr. Frankland has shown that the pale, smokeless flame of a spirit lamp may, by condensing the air around, be made as bright as that of coal gas, and that by pushing the condensation far enough, it may be even rendered smoky. (See Tyndall's Heat, 4th ed., pp. 46-52).

(3) *On the presence of solid particles within the area of combustion.*—All illuminating bodies in use, as coal gas, oil, wax, tallow, fats, etc., are hydrocarbons—i. e. they consist of a mixture of various compounds of carbon and hydrogen in different proportions, having the general formula $\text{C}_m \text{H}_n$. Directly we apply heat the oxygen of the air seizes on the hydrogen of the hydrocarbon producing the heat of the oxyhydrogen flame. The carbon is set free in innumerable solid particles, which are raised by the burning hydrogen to a state of incandescence. It is to these white-hot particles of carbon that the light of coal gas, our lamps, etc., is due. (Condensed from Kemshead's Chem.)

8. See Roscoe's Primer, p. 96:

65 lbs. Zn give 161 lbs. Zn SO_4 ,
 $\frac{65}{161} \times 3\frac{1}{2}$ lbs. Zn give $3\frac{1}{2}$ lbs. Zn SO_4 ,
 $1\frac{1}{2}\frac{1}{2}$ lbs. Zn.—Ans.

Correspondence.

STRONG AND WEAK VERBS.

(As Mr. Mason's Grammars are so deservedly popular in Canada, we are sure our readers will be pleased to read his treatment of the above subject. The following letter was written to the *Educational Times* in reply to the Rev. Canon Daniel, whose work Mr. Mason had previously criticized.)

SIR,—In his reply to my criticism on his treatment of Strong and Weak Verbs, Canon Daniel makes a charge which I claim permission to repel, and asks a question which I should like to be allowed to answer.

The charge against me is one of unfairness, or something worse, and is couched in the following terms:—

"Mr. Mason's mode of attack is, to say the least, somewhat extraordinary. He goes out of his way to assume a misprint in my book, and then, with much self-satisfaction, proceeds to demolish the errors that result from his own emendation. He assumes that I explain the past tense of weak verbs by reduplication. I do not

such thing. What I explain by reduplication is the distinctive ending of the past tense of weak verbs. That ending is *-ed*, *-d*, or *-t*, a vestige of the reduplicated past *did*."

I am aware that it is a common device in controversy, for the writer who is criticized to lay hold of some subordinate matter, as to which he thinks he has caught his adversary tripping, dangle this before the eyes of the reader as if it were the sum and substance of the whole affair, administer an indignant rebuke to the critic, and ride off with the honors of war. I should be sorry to think the Canon capable of doing this deliberately, but in his haste he has done what comes to much the same thing. Any one who takes the trouble to read carefully what I wrote, will see that it is a complete misrepresentation to state that "my attack" is based upon an assumed misprint. My criticism was mainly directed against the Canon's theory as to the way in which the vowel change in strong verbs is connected with reduplication, and his heresy on the subject of mixed preterites. The assumed misprint has nothing to do with either of these points. It was only by the way that I made the suggestion as to the misprint, as a possible clue to the explanation of the following very puzzling paragraph:—

"The origin of the distinctive ending of the past tense of weak verbs is to be found in the ancient mode of forming the perfect tense by reduplication, e.g., Lat. *curro*, I run, *cucurri*, I have run. The purpose of reduplication was obviously to give the impression that the action is thoroughly done. In Latin and Greek, instances of reduplication are common, but in English the only surviving traces of it are *did*, the past tense of *do*, and *hight*, the past tense of *hatan*, to be called. This reduplication was accompanied by a modification of the root vowel. In modern English the reduplicated syllable has been dropped, but the modification of the root-vowel which accompanied it has been retained."

Now, I beg the reader to observe that not a word has yet been said to the effect that the said "distinctive ending" has any connection at all with *did*. In the absence of any such clue to the meaning, I think he will admit that "the origin of the distinctive ending of the past tense of weak verbs" was naturally and fairly understood by me to mean "the way in which weak verbs come to have *-ed*, *-d*, or *-t* in the past tense." That this should have come about by reduplication, of course appeared "surprising" to me. Further, it needs very little consideration to see that the rest of the paragraph has all the appearance of having been intended to deal with reduplication as connected with strong preterites in general. Surely the suggestion of a misprint, not entirely the fault of the printer (hence part of my criticism), did not require me to go far "out of my way."

However, Canon Daniel ought to know best what he meant. Let us see, however, what his explanation compels him to abide by. The paragraph is reduced, of necessity, to being an account of reduplication as connected with *did*. Respecting this, then, we are told that "the only surviving traces of reduplication in English are *did* and *hight*," and that in modern English the reduplicated syllable has been dropped. How comes it to pass, then, that in both *did* and *hight* it is retained? Really I think the paragraph becomes more surprising than ever.

Now, when it is borne in mind that, if the above quoted paragraph be kept in its present form, we are actually left by Canon Daniel without any explanation whatever of the origin of the formation of the preterite of strong verbs in general, while we have two explanations of the origin of the distinctive ending of weak verbs (for we have all about the origin of the *-d* of weak verbs in the very next paragraph); and when it is observed that meaning and coherence at least are introduced into the above extract, while the desiderated explanation of strong verbs in general is restored, if for "the origin of the distinctive ending of the past tense of weak