XXX. *Of the Light produced by Inflammation.*

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WHEN a body is heated to a certain degree, it becomes luminous, and is ſaid to be ignited. One of the means of producing heat is inflammation; and this, as is well known, is ſufficient for ignition. But, I apprehend, that, beſides the light produced by ignition, there is alſo light produced by the inflammation itſelf. For the inveſtigation of this principle, it will be neceſſary to conſider ignition in the firſt place.

Subſtances, heated to between 6 and 700° of FAHRENHEIT's thermometer, begin to be luminous in the dark. If they be colourleſs, the light which is firſt obſerved is red; as the heat is increaſed, there is a mixture of yellow rays; and, laſtly, a due proportion of all the coloured rays to form a pure white, which has been commonly called, by chemiſts, a melting heat. The intenſeneſs of this light depends much upon the denſity of the heated body; for, while metals, heated to this degree, throw out a ſtrong light, the vapour at the end of the flame of a blow-pipe, properly applied to a lamp, is not viſibly luminous, though the heat be ſo great as immediately to give a white heat to glaſs. The colour of this light is affected

affected by the colour of the ignited matter. While *zinc* is calcining, the pure white *calx* throws off a light, which vies with that of the Sun in brightneſs and purity; the green *calx* of copper gives to the flame of a fire, in which it is calcining, a beautiful green; and tallow burning in a candle, being converted into empyreumatic oil, as it paſſes off from the wick, the yellow colour of this oil gives a yellowneſs to the flame, which very much alters the colours of objects ſeen by candle-light from what they appear to be in the day.

The light produced by the decompoſition of bodies in inflammation is totally independent of the heat, and its colour is blue; for ſubſtances which burn, without producing 600° of heat of FAHRENHEIT's thermometer, give light during their inflammation. Thus, *phoſphorus* of urine expoſed to the air burns and is decompoſed, producing light with very little heat; and that this is a true inflammation and decompoſition appears from this experiment. Take a receiver of white glaſs, capable of holding ſix or eight gallons; put into it a drachm of *phoſphorus* of urine, finely powdered, and half an ounce of water; cork the mouth of the receiver, and tye it over with a bladder, ſo as to exclude the external air; incline the receiver to all ſides gently, and afterwards ſet it to reſt; the powder will adhere to the ſides, and the water will drain from it. As ſoon as the water is ſufficiently drained off, the particles of the *phoſphorus* will become luminous, and emit a thick ſmoke: this will continue for ſome days; but at laſt no more light or vapour will

appear. Open the receiver, and you will find, that the air will have contracted, as it does from the inflammation of a candle in VAN HELMONT's experiment; that is, about a twentieth part. It is become unfit for inflammation; for if a lighted candle be immerſed in it, it will be extinguiſhed as well as the *phoſphorus*, and an animal will be ſuffocated by it. The air then has ſuffered the ſame change, as that air which has ſerved for the inflammation of other bodies; and the *phoſphorus* is partly decompoſed, the water in the receiver being impregnated with its acid, and the air ſaturated with its phlogiſton. Blow freſh air into the receiver, and the light and ſmoke will immediately re-appear. In like manner, it is known, that ſulphur will burn and give light, without heat ſufficient for ignition. Take a piece of iron heated nearly red hot, and throw a little gun-powder upon it. If the heat be of a proper degree, the ſulphur will burn off with a blue flame, without heat ſufficient for ignition; for, if ſuch heat had been produced, the gun-powder would certainly have taken fire, which it does not. It is the inflammation and decompoſition of the ſulphur, and not its evaporation, which produces the light; for, if we ſublime ſulphur in cloſe veſſels, made of the moſt tranſparent glaſs, no light will be viſible, except at the very beginning, when a ſmall portion of it burns till the air in the veſſel be ſaturated, and rendered unfit for inflammation.

That the light, which is produced by the decompoſition in inflammation, is blue, in whatever degree of heat the

the inflammation takes place, appears from obſerving the bottom and lower part of the flame of a candle, where the inflammation is; the light produced is blue. Or take a candle which has burnt for ſome time, extinguiſh it by applying tallow to the wick, and let it ſtand to cool; afterwards ſet it on fire by the flame of another candle: at firſt, no more vapour will ariſe than can be acted upon by the air at once; inflammation, therefore, will go on in the whole ſmall flame, and it will be blue. It may be neceſſary to obſerve here, that, when a candle burns, the following proceſs happens. The tallow boils in the wick, and is converted into empyreumatic oil, riſing from it in the form of vapour. As it riſes from every part of the wick, the volume is increaſed till it comes to the top, and gives to the lower part of the flame the form of a *fruſtum* of an inverted cone. The air is applied to the outer ſurface of the column of vapour, and, there decompoſing the empyreumatic oil, produces heat and blue light; the *ſtratum* of vapour, within the outer burning ſurface, is heated white-hot; the heat diminiſhes towards the center, which, if the flame be large, is ſcarcely red-hot; as the column riſes, decompoſition taking place conſtantly on its ſurface, it neceſſarily diminiſhes, and the upper part of the flame is conical. That the tallow boils in the wick can be ſeen; that it is converted into empyreumatic oil is proved by drawing the vapour, riſing in the middle of the flame, where it does not burn, into a glaſs tube; the empyreumatic oil condenſes. This alſo ſhews, that the flame does not burn in the middle. That the heat is

produced on the outer ſurface appears, if we take a ſmall rod of glaſs, and put the end of it in the blue flame on the ſurface; it will be heated white-hot and melt. Immerſe the rod into the flame, ſo that the point ſhall be in the center, it will melt and bend, where it is in the blue flame on the ſurface; whereas, if the flame be large, the point which is in the center will hardly be heated red-hot. That the empyreumatic oil is decompoſed is proved by burning a candle with a very ſmall wick in diſtilling veſſels, no condenſation of empyreumatic oil takes place. We may conclude, therefore, that light is produced by the decompoſition, as well as by the ignition, in inflammation.

I will not take up the time of this learned Society in applying theſe principles to the explanation of various appearances in burning bodies; or ground upon them any practical rules for producing ſtrong or faint, white or coloured light, theſe being ſufficiently obvious. I have choſen to illuſtrate this ſubject by experiments that may be the moſt eaſily tried; but, leſt the manner of powdering *phoſphorus* ſhould not be known, I will give the proceſs. Take *phoſphorus* of urine two drachms; put it into a four-ounce phial; pour upon it three ounces of water; heat it gently, by immerſion in warm water, till the *phoſphorus* melts; ſhut the phial with a cork; take it out of the water, and ſhake it briſkly till it be cold; the *phoſphorus* will be found in powder.

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