
ON CERTAIN LOW-LYING METEORS.

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1.—THE IGNIS FATUUS.

THE term "low-lying meteors" involves something like a contradiction, since the word "meteor" (*μετεωρος*, "high") originally referred to appearances in the upper regions of the atmosphere, such as the *Aurora Borealis*. As science advanced, the word was extended to all the varied phenomena that are connected with the weather and embodied in the term "meteorology." Our present purpose, however, is to give some details on a subject that seems to have fallen into hopeless confusion—namely, the phenomena to which the term *ignes fatui* has been applied by the English, *feux follets* by the French, and *Irrlichter* by the Germans.

Some old pupils of mine were seeking for information on the subject of the *ignis fatuus*, or "will-o'-the-wisp," also known as "jack-o'-lantern," and turned to one of those popular books grandly styled "Guides to Knowledge," and read as follows:—

"This luminous appearance (which haunts meadows, bogs, and marshes) arises from gas of putrefying animal and vegetable substances, especially from decaying fish. These luminous phantoms are so seldom seen because phosphoric hydrogen is so very volatile that it generally escapes into the air in a thiuly diffused state. They fly from us when we run to meet it, because we produce a current of air in front of ourselves (when we run towards the *ignis fatuus*) which drives the light gas forwards. It runs after us when we flee from it, because we produce a current of air in the way we run, which attracts the light gas in the same course, drawing it after us as we run away from it. The Welsh "corpse candles" are the same thing as the *ignis fatuus*. Swarms of luminous insects passing over a meadow sometimes produce an appearance similar to the *ignis fatuus*."

This passage contains nearly as many blunders as lines. The *ignis fatuus* is not seen in meadows; it is not due to putrefying animal matter; there is no such gas as phosphoric hydrogen—the gas really meant is one of a series of inflammable compounds, in naming which the Latin word *uret* ("it will burn") is introduced, such as phosphuretted hydrogen, carburetted hydrogen, &c., but now known by the shorter terms "phosphide," "carbide," &c. As a specimen of English composition may be noted the

sentence, "They fly from us when we run to meet it." The Welsh corpse candles and the luminous insects wind up appropriately a series of mistakes.

On turning to so respectable a publication as the *English Cyclopædia* (Arts and Sciences Division), 1860, the *ignis fatuus* is described as a meteor resembling a flame, which is vaguely said to do a number of things, and may be seen over marshes and burial grounds; and the case is related in which a weak blue flame came up from the sea, and burnt some ricks of hay. It is also stated that "such meteors are most usually witnessed during a fall of rain or snow." After referring to some other cases, the writer remarks, "Little confidence can be placed in the descriptions given of them, as few persons have been able to examine them with due attention; and commonly they have been observed under the influence of an ill-regulated imagination rather than a philosophical spirit." That such meteors are due to phosphuretted or carburetted gas is termed "a plausible hypothesis," but "there is a great dearth of satisfactory observations on moving lights seen in Nature, and the entire subject is at present in obscurity."

In the ninth edition of the *Cyclopædia Britannica* the subject is treated, oddly enough, under *Phosphorescence*, which is said to be a name "given to various phenomena due to different causes, but all consisting in the emission of a pale, more or less ill-defined light, not obviously due to combustion." It is stated that the *ignis fatuus*, as seen in marshy districts, has given rise to much difference of opinion. Kirby and Spence suggested that it might be due to luminous insects, "but it is more reasonable to believe that the phenomenon is caused by the slow (?) combustion of marsh-gas."

In *Chambers's Cyclopædia* (a Dictionary of Universal Knowledge), new edition, Vol. VI., 1890, the article *Ignis Fatuus* seems to have been entirely derived from the article *Irrlichter* in the *Konversations-Lexicon*. In this there is the same uncertainty in the treatment of the subject, and the same confusion as in the earlier writers, arising from the application of the same term to meteors of very different origin. The article begins by stating that the *ignis fatuus* "is a luminous appearance of uncertain nature, which is occasionally seen in marshy places and churchyards. The phenomenon has been frequently described, but it has been observed so rarely in favourable circumstances by scientific men, that there is no satisfactory explanation." The theory that the meteor is due to ignited marsh-gas is dismissed as untenable, because the gas does not ignite spontaneously. The more plausible suggestion, that it is due to phosphuretted hydrogen, which ignites on contact with oxygen, is also rejected, on the ground that a German observer "passed his hand through the luminous appearance, and felt no warmth"; while another German "held the metal tip of a walking stick in the flame of a fixed *ignis fatuus* . . . for a quarter of an hour, but the metal was not warmed." The luminous appearances here referred to were evidently electrical, not gaseous, as was also the meteor, which was seen to "bound over the country like a ball of fire for half an hour at a time."

It is sufficiently evident that the compilers of the articles just quoted were not scientific chemists, nor had ever had any experience in laboratory practice. They seem to have derived their information from some of the older books of science, in which certain natural phenomena are attempted to be explained before the science of the subject had been discovered. Thus, previous to Franklin's great discovery of the identity of lightning with common or frictional electricity, that brilliant meteor was supposed to be due to the oil of plants evaporated during the heat of the day,

and set on fire in the sky. Ignorant, too, of gases, they could not explain phenomena due to that source. What they wrote up to the science of their time they generally wrote well, but they had the unfortunate habit of explaining within the terms of their own knowledge what lay far beyond it, and which it was the function of future men of science to discover. Such a writer was Dr. Van Musschenbroek, Professor of Mathematics and Philosophy in the University of Leyden. His Latin treatise on Natural Philosophy was translated by John Colson, M.A., F.R.S., Lucasian Professor of Mathematics in the University of Cambridge, and was printed for J. Nourse at the "Lamb," without Temple Bar, 1744. The following paragraph is copied from Vol. II., p. 291:—

"§ 1329. *Wandering fires*, or *ignes fatui*, are of a round figure, in bigness like the flame of a candle, but sometimes broader, and like bundles of twigs set on fire. They sometimes give a brighter light than that of a wax candle, at other times more obscure, and of a purple colour. When viewed near at hand they shine less than at a distance. They wander about in the air, not far from the surface of the earth, and are more frequent in places that are unctuous, muddy, marshy, and abounding with reeds. They haunt burying places, places of execution, dunghills. They commonly appear in summer, and at the beginning of autumn. But in the country about Bononia they are seen throughout the whole year in a dark night. For there in a cold winter, and when the ground is covered with snow, they are in greater plenty than in the hottest summer. Those, also, are observed in winter which Gassendus says are seen at Rogon, a town of Provence. They appear more frequently in hot than in cold countries. In Italy, near Bononia, are the greatest, and in the greatest plenty. Sometimes they vanish on a sudden, and presently shine out in another place. They are generally at the height of about six feet from the ground. Now they dilate themselves, and now contract. Now they go on like waves, and rain, as it were, sparks of fire, but they burn nothing. They follow those that run away, and fly from those that follow them. Some that have been catched were observed to consist of a shining, viscous, and gelatinous matter, like the spawn of frogs, not hot or burning, but only shining, so that the matter seems to be phosphorous, prepared and raised from putrefied plants or carcases by the heat of the sun, which is condensed by the cold of the evening, and then shines. Yet I do not think that the matter of all is the same, for without doubt those of Bononia differ from those of Holland. It is a mere fiction that these fires are evil spirits, or wandering ghosts, misleading travellers out of mere spite, to plunge them into ditches and bogs, as some trifling philosophers have told us."

In the above passage there are some good descriptions of low-lying meteors, but the writer cannot reconcile the phenomena as due to one source, for he does not suppose that "the matter of all is the same." With our present knowledge it is easy to recognize, in his description, three varieties of low-lying meteors, namely, the gaseous of two kinds, and the electrical. On the present occasion we will trace the history of the *ignis fatuus* properly so-called, reserving for another article the consideration of the other two meteors.

The first step towards a true explanation of the *ignis fatuus* was taken by Priestley, who in 1767 commenced his "Experiments and Observations on different kinds of Air," and thus laid the foundation of pneumatic chemistry. Among his experiments are a considerable number on the inflammable air produced during the decomposition of various kinds of vegetable matter, and he says: "The air from marshes also, which, with Sig. Volta, I doubt not comes from putrefying vegetable substances, I have also found to be equally permanent," that is, not absorbed by water as in the case of fixed air. Volta distinctly stated that the gas from marshes is the cause of the *ignis fatuus*, and that the gas is kindled by lightning or by an electric spark.

The next step was taken by the Abbé Bertholon, Professor of Experimental Physics at Languedoc, and member of various scientific societies. In 1787 he published a work on meteors, containing a chapter on the

ignis fatuus. Taking advantage, apparently, of Priestley's discoveries—for, as he appropriately remarks, it was impossible to explain the *ignis fatuus* before gases were discovered—he proceeds to describe the following capital experiment, which we must let him relate in his own language:—

“Il est bien prouvé, par l'expérience et l'observation, que dans les marais, et les terrains marécageux, il y a de l'air inflammable; il suffit, pour en obtenir, de remuer avec une canne la vase de ces endroits, aussitôt on verra s'en échapper, à travers de l'eau qui en couvre plus ou moins la surface, une quantité assez considérable. Si dans cet instant on approche la lumière d'une bougie on verra aussitôt l'air inflammable s'allumer, et la flamme s'étendre au loin.”

The gas thus formed has been collected in bottles full of water inverted in the water of the marsh with a funnel in the neck of the bottle. On stirring the mud below, the gas enters the funnel in bubbles, and, rising up, displaces the water in the bottle. It was found by Sir Humphry Davy and others to contain carbonic acid and a small quantity of nitrogen, the proportion of either or both of which would, of course, influence the character of the flame. Davy found the pure gas to consist of four parts of hydrogen in chemical union with one part of carbon, identical in composition with the fire-damp of the coal mine. It is known as marsh-gas, or light carburetted hydrogen. It is the only source of the *ignis fatuus*, properly so called. It is ignited either by lightning or by an accidental flame. I knew it in one case to be ignited by a labourer passing by a marsh lighting his pipe and throwing the match away. Another case has recently come under my notice. An old pupil of mine informed me that four or five years ago he was rowing in a boat with some friends on a pool of some three acres in extent. A stream of water flowed through it, but the pool was stagnant, or nearly so, in the rear of an island in the pool. At this spot he noticed large bubbles of gas rising and bursting, and at once surmised that they contained marsh-gas. To test this he applied a lighted match, but not taking heed as to the direction of the wind, the flame from a large bubble instead of being blown away from him was blown towards him, and burnt all the hair from off the back of his hand. Many trees grew near the spot, and leaves fell abundantly into the water, so that in the course of years the decaying matter had produced a considerable deposit of mud, which necessitated the emptying and cleansing of the pool, after which the production of marsh-gas ceased.

The *ignis fatuus* is now seldom or never seen, and the reason is that the places which produced it have been drained and brought under cultivation. Some years ago, however, Major Blesson of Berlin made a number of capital experiments on the subject in a valley in the forest of Gubitz, in the Neumark, where the meteor had been often seen. The valley cuts deeply into compact loam, and is marshy at its lower part. The water of the marsh contains iron, and is covered with a shining crust. During the day bubbles of gas were seen rising from it, and at night bluish-purple flames were observed playing over the surface. On visiting the spot by night, the sensitive flames retired as the major advanced; but on standing quite still, they returned, and he tried to light a piece of paper at them, but the current of air produced by his breath kept them at too great a distance. On turning away his head, and screening his breath, he succeeded in setting fire to the paper. He was also able to extinguish the flame by driving it before him to a part of the ground where no gas was produced; then applying a flame to the place whence the gas bubbles issued, a kind of explosion was heard over eight or nine square feet of the marsh; a red light was seen, which faded to a blue flame about three feet high, and this continued to burn with an unsteady

motion. As the morning dawned the flames became pale, and seemed to approach nearer and nearer to the earth, until at last they faded from sight. The same observer also made experiments in other places. At Malapane, in Upper Silesia, he passed several nights in a forest where the meteor was to be seen. In the Komski forest, in Poland, the flame appeared of a darker hue than usual, and on attempting to ignite paper and shavings of wood they became covered with a viscous kind of moisture, as in Musschenbroek's observation, when an *ignis fatuus* was “caught.” On another occasion he succeeded in lighting up the meteor by standing at a distance and hurling ignited fireworks into the marshy ground. He visited by night the summit of the Porte Westphalia, near Minden; the meteor was not visible, but on firing a rocket into the marsh a number of small red flames were observed, which soon went out, but appeared again on firing another rocket.

Hence, it will be seen that the *ignis fatuus*, or “will-o'-the-wisp” or “jack-o'-lantern,” is due to the ignition of a gas arising from the decay of vegetable matter, and known as marsh-gas, or light carburetted hydrogen. Low-lying meteors due to phosphorus and electricity will be treated of in another article.

[JUNE 1, 1893.]

PHOSPHORESCENT METEORS.

To the Editor of KNOWLEDGE.

DEAR SIR,—Some twenty years ago I had an experience similar to that recorded from Thurso, in Prof. Tomlinson's paper in KNOWLEDGE.

I was staying the night with a friend. We sat up late, and when he had gone down to see that the house was safe, he returned rather promptly with the news that there was someone in the pantry, for he could see a light. Arming ourselves with the fire-irons, we crept downstairs.

The pantry was between the basement passage and the scullery, without external ventilation. As we turned towards the wire gauze door, the light was plain enough, rather bigger than a large open hand.

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Advancing cautiously, we found the light came from a sole that had been skinned, and was hanging from a shelf. It had been kept too long, and looked transparent, the bones showing distinctly brighter than the rest.

Not long since I saw a notice of some “luminous eggs,” which probably were not very fresh.

Yours very truly,

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April 29th, 1893.