

XXI. *A Continuation of the Experiments and Observations on the Light which is spontaneously emitted from various Bodies ;* with some Experiments and Observations on solar Light, when imbibed by Canton's Phosphorus.* By Nathaniel Hulme, M. D. F. R. S. and A. S.

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SECTION XI.

The Effects of various aerial Fluids on spontaneous Light.

INTRODUCTION.

THE apparatus employed for experiments with any kind of air, unless otherwise expressed, consisted of the following parts :

1. A tea-saucer, holding about three ounces of water.
2. A wide-mouthed phial, which would contain about ten ounces of liquid.
3. A small wooden stand, composed of a slender pillar or pin, nearly four inches high, fixed into a round base, a little more than an inch in diameter, and half an inch thick. This stand was fastened by strong thread to the middle of a piece of flat lead, such as lines Chinese tea-chests, having holes in it to admit the thread ; the lead was about three inches square, and doubled, to give it weight and stability. The top of the pillar was made pointed ; and a round piece of cork, about an inch in diameter and half an inch thick, was fixed upon it, by means of a superficial hole bored in its under part with a gimlet.

* See Phil. Trans. for 1800, page 161.

When the whole apparatus was put in use, the phial was filled with cold pump water, in a pneumatic tub, then inverted, and the species of air to be employed was let up into it, to the quantity of about eight ounces. The subject for experiment being applied to, or fastened upon, the top of the cork, the stand was placed on the tea-saucer, and then introduced, under water, into the phial containing the air. The whole apparatus, being now supported by the tea-saucer, with water in it, was deposited in the laboratory for experiments on light. By this contrivance, the experiments were made in about eight ounces of air, by measure, confined above two ounces of water.

§ 1.

The Effects of common or atmospherical Air on spontaneous Light.

EXPERIMENTS.

Exper. 1. Two fresh herrings were hung up together in the laboratory, so as to touch each other at their flat sides; and it was observed that the parts in contact remained dark, while those exposed to the open air became very luminous.

Exper. 2. Another fresh herring was laid upon a piece of thick brown paper, and placed in the laboratory. On examination, the next evening, the upper part, which was exposed to the air, was very lucid; but the underside, lying upon the paper, remained quite dark.

Exper. 3. A luminous herring was divided transversely quite through its middle fleshy part; but the inside was perfectly dark. On the following night, that which before was dark had become luminous.

Exper. 4. At 9 P. M. a piece of fresh herring, of about three drams in weight, was introduced above water, into about eight ounces of atmospherical air. On the second night it was become luminous; on the third and fourth, it continued shining; and on the fifth the light was extinguished. This experiment was frequently repeated, with both the flesh of herring and of mackerel, and nearly with the same result.

Exper. 5. The cork of the apparatus was well smeared with the luminous matter of a mackerel, and then introduced above water. It continued to shine finely all that evening; and the light was not quite extinct on the succeeding night.

Exper. 6. Another cork was illuminated with herring-light, at half an hour past six P. M. and introduced above water. It remained very bright at eleven; and retained a glimmering light the next evening. The two last experiments were often repeated, and, in general, with similar effects. It may not, however, be improper to observe, that the illumination of the cork did not always continue so long as twenty-four hours; for it must, of course, vary according to the quantity of luminous matter applied, and its degree of brilliancy.

Exper. 7. A large piece of rotten wood was received from the country, which shone only in one place. The luminous portion was sawed off for use, and the dark part left in the laboratory. On going into the laboratory, the second night after this operation, I was surprised to see the dark piece, which had been left there, very lucid in several places where small splinters had been broken off in sawing; many shining fragments also lay scattered on the floor.

Exper. 8. A quantity of rotten wood, moderately shining,

was blown upon for some time with a pair of bellows; but I could not perceive that this had any effect on the light, so as to render it more vivid.

Exper. 9. A small piece of shining wood was tied upon one of the corks of the apparatus, and introduced above water, where it continued lucid until the fifth night. In another experiment, the light was extinguished on the fourth night; and in a third much sooner.

Exper. 10. A living glow-worm, in a shining state, was submitted to the action of a pair of bellows; but the continuance of the blast did not apparently increase its glowing quality.

Exper. 11. A very luminous dead glow-worm was fixed upon a cork of the apparatus, by means of a small pin, and then put into the phial, above water. It continued to shine as vividly as it did when in the open air, forming a pure white light, of a circular shape.

OBSERVATIONS.

Obs. 1. These experiments prove, that objects which abound with spontaneous light in a latent state, such as the herring, mackerel, and the like, do not emit it when deprived of life, except from such parts as have been some time in contact with the air.

Obs. 2. They likewise show, that the blast of a pair of bellows does not increase this species of light, as it does that which proceeds from combustion.

§ II.

The Effects of oxygen Gas or vital Air on spontaneous Light.*

EXPERIMENTS.

Exper. 1. A piece of fresh herring, of about three drams weight, was introduced above water, into eight ounces of oxygen gas. On the second night it was observed to be faintly luminous; on the third, the quantity of light was increased; on the fourth, it continued nearly in the same state; and on the fifth the light was diminished.

Exper. 2. A piece of very fresh mackerel, of the same magnitude, was also put above water. On the subsequent evening it was pretty lucid, and continued the same on the night following.

Exper. 3. At 9 P. M. a cork, finely illuminated with mackerel-light, was introduced above water: it continued very lucid at eleven. On the next evening it was dark.

Exper. 4. Another cork, rendered luminous with the same kind of light, was put above water at 10 P. M. The next morning, at six o'clock, only a glimmer of light was perceived, and at 10 P. M. it was extinct.

Exper. 5. At 9 P. M. a fragment of shining wood was introduced above water: it was observed to be still very luminous at eleven; but the light was not quite so vivid, nor so extended in breadth, as when the wood was put in. On the succeeding night, at eight o'clock, it remained faintly lucid.

Exper. 6. A little after 8 P. M. another fragment of wood,

* The oxygen gas made use of was obtained from manganese, by means of heat.

shining very brightly, was introduced above water, into the same air that was used in the last experiment: it continued very luminous at eleven; but the light was diminished in quantity. On the next evening it was found to be extinguished.

Exper. 7. The same air was employed again at 8 P. M. with a pretty large and thick fragment of wood, uncommonly lucid: its light continued vivid and broad at half an hour past eleven. The following night, at eight o'clock, the light was still somewhat extensive and bright.

Exper. 8. In three other experiments with shining wood, in fresh oxygen gas, the light was totally extinguished in the space of twenty-four hours.

Experiments were made, at the same time, and in the same manner, with atmospherical air and shining wood; but it was not very evident that the wood shone more vividly in the latter air than it did in the oxygen gas.

Exper. 9. A living glow-worm was put into a two-ounce phial, with a glass stopple, containing pure oxygen gas, and kept therein for some time. It was then taken out, and exposed to the open air; but no difference, either in the brilliancy or the quantity of its light, could be discovered.

Exper. 10. A luminous dead glow-worm was then inclosed in about five ounces of the gas; but no increase of its shining quality could be perceived.

Exper. 11. At six o'clock P. M. a shining dead glow-worm was introduced above water into oxygen gas: it continued very lucid therein at 7 P. M. shewing a pure white light. It was then taken out, and put above water into atmospherical air, where it shone, to all appearance, as splendidly as it did when it was in the oxygen gas.

OBSERVATION.

It appears, from these experiments, that oxygen gas does not act upon this kind of light, so as to render it much more vivid than it is in atmospherical air; which is quite contrary to what some authors have alleged.

§ III.

The Effects of azotic Gas on spontaneous Light.

1. *Azotic Gas, obtained from lean muscular Flesb and diluted nitric Acid, in a very low Heat, as recommended by M. de FOURCROY.*

EXPERIMENTS.

Exper. 1. A piece of fresh mackerel, weighing about three drams, was introduced above water, into about eight ounces of this azotic gas; and it was retained therein five days, without emitting any light.

Exper. 2. About the same quantity of fresh herring was then put above water, into the same gas used for the last experiment, and remained in it for the space of three days, in a dark state. This experiment was repeated, and with a similar result.

Exper. 3. At 45 minutes past 7 P. M. a cork, finely illuminated with mackerel-light, was put above water into the gas, and it was found pretty luminous at eleven. On the next evening, at eight o'clock, it still exhibited a faint degree of light.

A similar experiment was made, at the same time, in atmospherical air. At 11 P. M. the cork was but moderately luminous; and on the next evening it was dark.

Exper. 4. At 40 minutes past 7 P. M. another cork, rendered very luminous with herring-light, was introduced above water. This cork, at 11 P. M. was not found so lucid as that in the third experiment. On the next evening, a glimmer of light was still perceptible.

Exper. 5. A fragment of very shining wood was introduced above water, into this gas; and it was rendered dark in about 15 minutes.

Exper. 6. The experiment was repeated; and the light was again extinguished in about 15 minutes. In another experiment, it was extinguished in about 25 minutes.

II. *Atmospheric Air rendered azotic, by burning Spirit of Wine in it, when confined above Water.*

Exper. 7. A portion of fresh herring, of about three drams, was put above water, into this azotic gas, at 5 P. M. On the second evening, a spark of light was observable; on the third, the quantity of light was increased; on the fourth, it was again diminished.

Exper. 8. At 3 P. M. the usual quantity of herring was introduced above water. On the second night, it remained dark; on the third, it was moderately luminous; on the fourth, it was less so; on the fifth, the light was extinct.

Exper. 9. A piece of fresh mackerel was next put above water, at 11 A. M. On the second evening, it was found to be slightly luminous; it remained so on the third; on the fourth, it was dark.

Exper. 10. Another piece of fresh mackerel was introduced above water, at 3 P. M. On the second night, it was found to be slightly luminous; but on the third, it was dark; and no

more light was emitted, though it was kept in the gas for the space of four days.

Exper. 11. A cork, made very luminous with herring-light, was put above water, into this gas, at 20 minutes past 8 P. M. and it continued very lucid at eleven. The next evening, at ten o'clock, the light was nearly extinguished.

A similar experiment was made, at the same time, in common atmospherical air, and with the same result.

Exper. 12. Another cork was introduced above water, with herring-light, at 40 minutes past 7 P. M. and it remained pretty luminous at eleven. On the following night, it was nearly extinct.

III. *The last mentioned azotic Gas, after being washed with Lime Water.*

Exper. 13. A piece of herring, of about three drams weight, was put above water, into this azotic gas, at 5 P. M. On the second night, it was dark; on the third, very lucid; and on the fourth, the same.

Exper. 14. The experiment was repeated, on a piece of herring, at 3 P. M. On the second evening, it was dark; on the third, pretty luminous; on the fourth, it was less so; and on the fifth, only a faint light remained.

Exper. 15. A portion of fresh mackerel was then put above water, at 11 A. M. On the second night, it was observed to be moderately shining; on the third, the light was extinct.

Exper. 16. Another piece of fresh mackerel was introduced above water, at 3 P. M. On the second evening, it was slightly luminous; on the third, it was dark, and continued so during the four succeeding nights.

Exper. 17. A cork, finely illuminated with herring-light, was next introduced above water, into this gas, at 20 minutes past 8 P. M. The light was much diminished at 45 minutes past 8; at 11 the cork had become almost dark. On the following night, a glimmer was still apparent.

Exper. 18. Another cork, made very luminous with herring-light, was put above water, at 40 minutes past 7 P. M. and it continued pretty lucid at eleven. On the next evening, the light was merely visible.

A similar experiment was made, at the same time, in atmospheric air, and with nearly the same effect.

OBSERVATION.

It is a remarkable circumstance, that azotic gas, which is incapable of supporting light from combustion, should be so favourable to the spontaneous light which is emitted from fishes, as to preserve its existence and brilliancy for some time, *when applied upon a cork*; yet that it should prevent the *flesh* of the herring and the mackerel from becoming luminous, and also extinguish the light proceeding from rotten wood.

§ IV.

The Effects of hydrogen Gas or inflammable Air on spontaneous Light.*

EXPERIMENTS.

Exper. 1. At 9 P. M. a piece of fresh herring, weighing about three drams, was introduced above water, into hydrogen gas.

* This gas was obtained from zinc and diluted sulphuric acid.

It was retained therein three days and three nights, without emitting any light. It was then taken out, and exposed to the action of atmospherical air. On the following night it was found to be luminous; but was dark again on the next night.

Exper. 2. Another piece of fresh herring was put above water, at 6 P. M. This was also kept in the gas the same length of time, without producing any light. It was then exposed to the open air, and inspected two successive nights, but it remained dark.

Exper. 3. The same experiment was then made with a piece of mackerel, which was taken out on the fourth night, without producing any shining appearance. The next evening, it emitted a very faint light, which did not continue twenty-four hours.

Exper. 4. A cork, brilliantly illuminated with mackerel-light, was introduced above water; and the light was extinguished in about the space of an hour.

Exper. 5. At 39 minutes past 9 P. M. another luminous cork was put above water; it lost some of its light pretty soon, but was not extinct at twelve.

Exper. 6. A cork, with herring-light, was introduced above water, at 23 minutes past 6 P. M. The light gradually diminished, and was only faintly visible at eleven.

Exper. 7. A fragment of very shining wood was put above water, at 9 P. M. and was dark at eleven.

Exper. 8. Another fragment was put above water, at 40 minutes past 8 P. M. at 50 the light was much diminished, and at 8 minutes past 9 the shining ceased. The wood was then taken out, and exposed to the open air, when the light revived in a very beautiful manner.

Exper. 9. A piece of uncommonly shining wood was introduced above water, at 58 minutes past 8 P. M. it remained for a short time very luminous, but at 25 minutes past 9 the light was greatly diminished; at 20 past 10 it was nearly extinguished; and at 29 past 10 was quite dark. It was then exposed to atmospheric air, and the light revived very brightly.

Exper. 10. The same experiment was repeated, at 35 minutes past 8 P. M. the shining property was much diminished at 9; and at 10 it was very faint. The next evening, it continued merely visible. The wood was now taken out, and the light soon revived very strongly. The following night, it was still moderately lucid; but on the next evening nearly extinct.

Exper. 11. Finding, by the above experiments, that the light of shining wood was extinguished by this species of gas, and restored by atmospheric air, the following three trials were made, to discover, in some degree, how long its light might be kept in a latent state, and then be revived. At 9 P. M. several fragments of shining wood, tied up in a piece of gauze, were introduced above water, into the hydrogen gas, and the light was gradually extinguished during that evening. They were kept there in that dark state 48 hours, were then taken out, and exposed to the open air, when, after a little time, the light re-appeared.

Exper. 12. On the 2d of October, another fragment of exceedingly shining wood, two inches and an half long, and pretty thick, was put above water in the evening, and its light was gradually extinguished. On the second night, it was taken out perfectly dark, but its light recovered by degrees, and became brilliant. It was introduced again, that evening, into the same gas, and its light disappeared. On the third night, it was again

exposed to the open air, and the light revived as before. It was then reinstated and extinguished, and continued in a dark state, from the third to the fifth night, when, being again taken out, it soon shone in a pretty vivid manner. It was again introduced and extinguished as usual; and no observation was made of it, from some accidental circumstance or other, until the 10th of November in the evening, when it was taken out, and exposed to the open air for a length of time, but the light did not revive.

Exper. 13. A third fragment, somewhat larger than the former, and equally luminous, was put above water, at the same time as the one in the last experiment, where it was soon deprived of its light. It was retained there, in a dark state, from the 2d of October till the 10th of November; it was then taken out, and exposed to the action of atmospherical air, for several days, but there was no return of light.

Exper. 14. About 7 P. M. a shining dead glow-worm was introduced above water into the gas, and its light was soon extinct. It was then exposed to the open air, where, in a very short time, it shone as brightly as before.

Exper. 15. At half an hour past 9 P. M. the same glow-worm was again introduced above water; when its light in a short time disappeared. It was taken out for exposure to common air at 11, and its glowing property was immediately restored. It was again replaced in the gas, where it soon lost all its light a second time, and was kept in that dark state for 24 hours; when taken out, it continued dark for a little time, and then the insect gradually recovered its pristine splendour.

OBSERVATION.

From these experiments we learn, that hydrogen gas, in general, prevents the emission of spontaneous light, and also extinguishes it when emitted; but, at the same time, it does not hinder its quick revival, when the subject of the experiment is again exposed to the action of atmospherical air; although the light may have been a considerable time in an extinguished state.

§ v.

The Effects of carbonic Acid Gas or fixed Air on spontaneous Light.*

EXPERIMENTS.

Exper. 1. At 10 P. M. a piece of fresh herring, weighing about three drams, was suspended in a wide-mouthed ten-ounce phial, filled with carbonic acid gas, and closed with a cork and bladder. It was retained there for three successive nights; but emitted no light.

Exper. 2. The same experiment was made with a piece of herring, which was beginning to be luminous. On the next evening, the illumination was found to be extinct: nevertheless the herring was still kept in the gas, for three nights longer, but did not become lucid.

Exper. 3. At 7 P. M. a piece of fresh mackerel was introduced above water, into a wide-mouthed bottle, holding 24 ounces, which was completely filled with carbonic acid gas,

* This gas was obtained from powdered chalk, or marble, and diluted sulphuric acid.

and supported by a tea-saucer that held about three ounces of water. On the second night it was dark, and continued the same on the third. It was then exposed to the influence of atmospherical air, and, on the next evening, it was pretty luminous, and likewise on the succeeding night.

Exper. 4. At 9 P. M. a cork, smeared with the luminous matter of a mackerel, was put into a five-ounce wide-mouthed phial, filled with carbonic acid gas, and then closed with a glass stopple. It continued to shine pretty vividly for some little time; then the light gradually diminished, so that at twelve, only a small spark remained.

Exper. 5. At 10 P. M. another cork, illuminated with mackerel-light, was introduced above water, into 24 ounces of the gas; and its light was nearly extinct at twelve.

Exper. 6. At 8 P. M. a fragment of shining wood was put above water, into 24 ounces of the gas; and it had not been long there before the light disappeared. It was then taken out, and exposed to the action of atmospherical air, when its shining property soon returned.

Exper. 7. Another fragment of brightly shining wood was introduced above water, into the same quantity of the gas, at 10 P. M. and the light was extinguished in the space of an hour. After this, it was exposed to the open air, and the light gradually revived.

Exper. 8. At 8 P. M. a luminous dead glow-worm was put above water into the gas; its glowing appearance gradually faded, and in a short time became quite invisible. It was then taken out, and the light, by degrees, re-appeared as vivid as before.

OBSERVATION.

This gas, we find, has also an extinguishing property, with respect to spontaneous light; but, in general, the light returns, if the object of experiment be taken out, and exposed to the open air.

§ VI.

The Effects of sulphurated hydrogen Gas on spontaneous Light.*

EXPERIMENTS.

Exper. 1. At noon, a piece of a very fresh mackerel, with a bright eye, was introduced above water, into 24 ounces of this gas, and was retained therein for three successive evenings, without emitting any light. It was then exposed to atmospheric air; yet it continued dark on the two following nights: but, on the third, it was very luminous, and remained so on the fourth and fifth.

Exper. 2. The same experiment was then made with a piece of fresh herring, which was also kept in the above gas, for about three nights, without being luminous. After exposure to common air, it did not emit any light during the first 24 hours. However, on the subsequent night, it began to shine, had a very bright light on the following evening, and continued shining for several succeeding nights.

Exper. 3. A cork, smeared with the luminous matter of a herring, was put above water, into 24 ounces of the gas; and

* This gas was obtained from sulphuret of potash and diluted muriatic acid.

the light was extinguished in less than an hour. The experiment was repeated in the same gas, and with the same result.

Exper. 4. A cork, illuminated with mackerel-light, was introduced into the same quantity of gas; and was dark in half an hour.

Exper. 5. A fragment of shining wood, being put into the gas, became dark in eight minutes. A second piece became dark in five minutes. They were then taken out, and continued dark all that evening. On the next evening, one of the pieces was uncommonly lucid.

Exper. 6. At 10 P. M. another fragment of brightly shining wood was introduced above water, into 24 ounces of the gas, and was extinct at eleven. It was then exposed to the open air; but there was no return of light that evening. On the following night, it was found pretty luminous.

Exper. 7. A finely shining dead glow-worm was next put above water, into this gas, and its light was quickly extinguished. In a second experiment, in the same gas, the light was much slower in its extinction. In both instances, after the insect was withdrawn, and placed in atmospheric air, the light gradually revived.

OBSERVATION.

It is apparent, by these experiments, that sulphurated hydrogen gas extinguishes spontaneous light much sooner than carbonic acid gas, and that, in general, the light returns much more slowly, when the subject is exposed to atmospheric air.

§ VII.

The Effects of nitrous Gas on spontaneous Light.*

EXPERIMENTS.

Exper. 1. A piece of fresh herring was introduced above water, into this gas, at 3 P. M. and remained there four nights, without emitting any light: it was then withdrawn, and exposed to common air, for the space of three nights; but did not become lucid.

Exper. 2. The same experiment was made with a piece of herring beginning to be luminous; but its light was gradually extinguished: it was detained in the gas for three nights, and taken out dark. It was then exposed to the open air, for the three subsequent nights; but its shining appearance did not return.

Exper. 3. A cork with luminous matter, introduced above water, into this species of gas, had its light, in general, extinguished in from 10 to 30 minutes; and, when taken into common air, its light very seldom re-appeared.

Exper. 4. Fragments of shining wood, above water, in nitrous gas, were likewise commonly rendered dark in a very short space of time, as in three or four minutes; sometimes a fragment, if uncommonly luminous, would not be extinguished in less than six or eight minutes; and very seldom would the light revive, on exposing the wood to atmospherical air.

Exper. 5. A dead shining glow-worm being put above water, into this gas, its light was quickly extinguished; but, after the insect was taken into the common atmosphere, the

* This gas was obtained from copper and diluted nitrous acid.

light gradually returned. The experiment was thrice repeated, and with the same result.

OBSERVATION.

This species of gas, we observe to have totally prevented the emission of light, and to have quickly extinguished that which had been emitted: likewise that the luminous objects which had been under its influence, (except the glow-worm) did not experience a revival of their light, when taken out, and kept for some time in common air.

§ VIII.

The Effects of a Vacuum on spontaneous Light.

EXPERIMENTS.

Exper. 1. A piece of shining wood, of a moderate size, was put under the receiver of an air-pump, in a dark room; in proportion as the air was extracted, the light was gradually extinguished, and at last reduced to a mere point, just visible, owing most probably to a small residuum of air, which is always left, even in the most perfect machine. Fresh air was then leisurely admitted, and the light was immediately revived in a very beautiful manner. This experiment was frequently repeated, and always with the like effect.

Exper. 2. Some luminous matter of a herring, uncommonly bright, was smeared upon a piece of red blotting paper, and then submitted to the operation of the air-pump. The light became fainter and fainter, as the inclosed air was withdrawn, and at last nearly vanished; but brightened up as before, on the

influx of fresh air. The experiment was repeated, and with the same result.

SECTION XII.

Experiments and Observations on solar Light, when imbibed by CANTON'S Phosphorus.

§ 1.

The Effects of Heat on imbibed solar Light.

1. *The imbibed Light is rendered more vivid by a MODERATE Degree of Heat.*

EXPERIMENTS.

Exper. 1. Having prepared some CANTON'S phosphorus, and exposed it to the light of the sun, it was carried into the dark laboratory, to separate the illuminated parts from those that remained dark. In doing which, some luminous fragments were placed upon the palm of the hand, and retained there for some time, when it was observed, that the warmth of the hand considerably increased the degree of light.

Exper. 2. Some fragments of this illuminated phosphorus were put into a small phial, which was then closed with a cork, and suspended, by a string, in a quart of water heated to about 126° ; by these means, the light was rendered much more vivid than before.

Exper. 3. Some other pieces of the illuminated phosphorus were dropped separately into a glass tube 32 inches long, and $\frac{7}{10}$ bore, filled with water at about 120° . The light of each piece became exceedingly bright, as soon as it entered the hot

water; and they all descended, very luminous, from the top to the bottom, some quickly and others slowly, according to their gravity, making a very pleasing experiment.

Exper. 4. A large wooden bowl, about 12 inches wide, was next filled with water heated to about 110° , and then a quantity of illuminated phosphorus, partly in the form of powder, and partly in pieces of different magnitudes, was scattered over the whole surface of the water; all which pieces fell, with increased splendour, to the bottom, where they preserved their light for some time.

II. *The imbibed Light is extinguished by a GREAT Degree of Heat.*

Exper. 5. Some fragments of the phosphorus, rendered luminous, were exposed to a greater degree of heat, namely, by casting them into a tin vessel containing two pints of boiling water. They flashed with increased light, as soon as they came in contact with the water, fell precipitately to the bottom, in a lucid state, and then were gradually extinguished.

Exper. 6. *In which the degree of heat was still increased.* A small bar of iron, of about an inch square, was made red-hot, and laid horizontally in the laboratory, until, by cooling, it nearly ceased to shine. Some pieces of illuminated phosphorus were then put upon it in succession, and the light, in a moment, glowed with uncommon lustre, but was quickly after totally extinguished.*

* Solar light, when received merely on a piece of white paper, may also be rendered more luminous by heat, and then extinguished by it, as appears from an experiment made by the late Mr. B. WILSON, whose book on phosphori I had not seen before this Paper was drawn up.

III. *The imbibed Light, after being in a latent State, is excited and rendered luminous by the Agency of Heat.*

Exper. 7. Some small pieces of the phosphorus, after having been illuminated, were deposited in the laboratory; when the light by degrees faded away, and became totally invisible. They were kept in this dark state for the space of ten days, and then placed one after another upon a heated bar of iron, as in the last experiment, upon which they quickly became exceedingly luminous.

From an experiment made by the ingenious Mr. CANTON, I observe, that some of his phosphorus, contained in glass balls hermetically sealed, and heated in the above manner, gave a considerable degree of light, after it had been kept in a state of darkness more than six months. Phil. Trans. Vol. LVIII. page 342.

§ II.

The Effects of Cold on imbibed Light.

EXPERIMENT.

About 15 grains of the phosphorus were put into a half-ounce phial, containing two drams of cold pump water, that had been deprived of its air by boiling. The phial was then corked, and exposed for some time to solar light, whereby the phosphorus became finely illuminated. In this state, it was immediately put into a frigorific mixture, composed of snow and sea-salt, and retained there about 30 or 40 minutes, when it was taken out, and the light found to be totally extinguished. The phial was then placed in some water, at about 60° temperature, and the

light gradually revived, and became as brilliant as before it had been exposed to the cold. This experiment was frequently repeated, and always with the same result.

I cannot but remark, that in the course of experiments on this subject, the superior power of solar over that of spontaneous light was very apparent. For, the first trials being made in small phials, containing only atmospheric air with the phosphorus, the light was with some difficulty totally extinguished; and, after the phials were taken out of the frigorific mixture, the temperature of the laboratory would commonly soon revive the light, which rendered the experiments not altogether satisfactory. Finding it thus somewhat difficult to extinguish solar light *in air*, recourse was had *to water*, in the manner above described. This answered perfectly well; for the water, when frozen, gave a substantial body, as it were, to the imbibed light of the phosphorus, so as to enable it to retain the excess of cold arising from the frigorific mixture; thereby making the experiments quite satisfactory. When the phosphorus was thus surrounded by ice, only a few minutes stay in the frigorific mixture would generally be sufficient for a total extinction.

OBSERVATION.

From these experiments, compared with those recited in my former Paper on spontaneous light, it appears that solar light, when imbibed by CANTON'S phosphorus, is subject to the same laws, with respect to heat and cold, as the spontaneous light of fishes, rotten wood, and glow-worms.

P. S. In these experiments with solar light, the phosphorus was sometimes exposed to the direct rays of the sun, at other times to common day-light, in a northern aspect; and it was remarked, that it became somewhat more luminous by mere day-light, than by the rays of the sun.

It may also be proper to observe, that the above experiments were made with an improved preparation of CANTON'S phosphorus. This improvement, which was first made by Dr. HIGGINS, consists in omitting the pulverization of the shells. His method was, after calcining the oyster-shells, to put the pieces, both great and small, in layers, into a crucible furnished with a cover, and to sprinkle flowers of sulphur between each layer. After they had remained some time in the furnace, they were taken out, suffered to cool, and then kept in a large bottle with a glass stopple. For this communication, I am indebted to Mr. LEWIS of Holborn, near Southampton-street, who has an extraordinary dark room, where, at times, he amuses his friends with some beautiful appearances, arising from solar light imbibed by phosphorus prepared as above directed. A still further improvement of this phosphorus, it appears to me, may be made by substituting precipitated sulphur for the flowers of sulphur; and the experiments of this section were chiefly made with phosphorus so prepared.