BERTHELOT has recently succeeded in isolating several compounds of metallic chlorides with hydrochloric acid; in *Compt. rend.* he describes three such chlorhydrates of metallic chlorides, viz.:—

$CdCl_2 . 2HCl . 7H_2O$; $PbI_2 . HI . 5H_2O$; and $3AgI . HI . 7H_2O$;

and in another number of the same journal M. Ditté describes, among others, the salts $BiCl_3 . 3HCl$; $SbCl_3 . 3HCl$, &c. These hydrated salts are formed from their constituent compounds with a considerable evolution of heat, the amount varying from 11,000 to 15,000 units. The anhydrous salts readily undergo dissociation into their constituent compounds, and cannot therefore be readily obtained. Berthelot regards the formation and dissociation of these chlorhydrates as playing an important part in the mechanism of many chemical changes. Thus calomel is changed into corrosine sublimate and mercury by the action of hydrochloric acid: Berthelot would formulate this change as $Hg_2Cl_2 + xHCl = HgCl_2 . xHCl + Hg$ (attended with evolution of 9500 heat-units), with subsequent dissociation of the chlorhydrate of $HgCl_2$. Again in the reduction of metallic chlorides by hydrogen Berthelot supposes that chlorhydrates are produced, and that the heat thus developed aids in dissociating fresh quantities of the original metallic chloride; thus he would indicate the initial stage of the reduction of cadmium chloride by hydrogen, as:—

$$2CdCl_2 + H_2 = Cd + CdCl_2 . 2HCl.$$

M. WURTZ has recently been studying (*Compt. rend.*) the action of the ferment *Papaïn* on fibrin, whereby the fibrin is rendered soluble in water. The process appears to be analogous with many ordinary chemical changes in which the formation and decomposition of a compound are continually proceeding. Papaïn forms an insoluble compound with fibrin, which compound is then decomposed by the water present with formation of a soluble hydrated fibrin, and setting free of the ferment, which again acts on fresh quantities of fibrin.

IN the *American Chem. Journ.* Clarke and Stallo describe a series of experiments on the tartrates of antimony, wherein they are led to regard tartar emetic as the potassium salt of a new acid, to which they give the name *tartrantimonious*, viz. $Sb . C_4H_4O_6 . OH$. This acid they regard as derived from orthantimonious acid, $Sb(OH)_3$, which they have prepared in definite form. The behaviour of an aqueous solution of tartrantimonious acid towards heat is peculiar. Below 30° the solution remains nearly clear; at a few degrees above 30° a white curdy precipitate deposits; on evaporating in a water bath the curdy precipitate disappears and a transparent gummy mass remains, which is completely soluble in cold water, re-forming the original acid. These changes are shown to be expressible by the equations—

1. $C_4H_5SbO_7 + 2H_2O = SbH_3O_3 + C_4H_6O_6$; the curdy precipitate consisting of orthantimonious acid.
2. $C_4H_6O_6 + SbH_3O_3 - 2H_2O + C_4H_5SbO_7$; *i.e.* on heating, water is eliminated, and the original acid is reproduced.

IN a series of papers in the *Berliner Berichte* Th. Thomsen endeavours to show that the "molecular rotation" of many classes of compounds is, for each class, a simple multiple of a constant number. "Molecular rotation" he defines as rotatory power $\times \frac{\text{molecular weight}}{100} \left(\frac{M.(\alpha)_D}{100}\right)$. The constant for one group appears generally to bear a simple relation to that for other groups; in fact a constant may be found which belongs to many groups. Adopting a classification analogous to that of natural history, Thomsen shows that the constant 0·95 belongs to a large "class" of compounds; that this multiplied by 4 gives the constant (3·8) for the "family" of alcohols, and by 9 gives the constant (8·65) for the "family" of amides, &c. From a determination of the molecular rotation of compounds, aided by the use of these constants, he attempts also to deduce conclusions as to the chemical structure of the molecules of these compounds.

IN various papers noticed in this journal, Brühl attempted to show that the "molecular refraction" $\left[M.\left(\frac{\mu - 1}{d}\right)\right]$ of isomeric carbon compounds is constant when only "singly-linked" carbon atoms are present; and that variations in this quantity are to be traced to variations in the "linking" of carbon atoms. Janowsky (*Berliner Berichte*) maintains that slight differences are always noticeable between the molecular refractions of isomeric compound where isomerism is due not to "linking," but to "grouping" of carbon atoms: but he thinks that if the values of the refractive indices of such compounds are considered, better results are obtained than by calculating the molecular refractions. Brühl however had himself shown that the refraction indices of such isomers are not the same.

LANDOLT has gathered together in *Berliner Berichte* the more important data concerning the inversion of specific rotatory power of carbon compounds by the influence of heat or of inactive solvents: those data he supplements by further experiments of his own, and develops shortly the outlines of a mechanical theory analogous to that of Rammelsberg.

THE atomic weight of beryllium is still the subject of experiment. Emerson Reynolds has redetermined the specific heat of the pure metal (*Chem. News*) and obtained a number which points to 9·1 as the true atomic weight. The same value is assigned by Brauner, who (*Berliner Berichte*) criticises the arguments of Nilson and Pettersson, and attempts to show that the specific heat, specific volume, and general physical properties of beryllium oxide are more in keeping with the formula BeO (Be = 9·1) than with the formula Be_2O_3 (Be = 13·6) assigned to it by the Swedish observers.

IN a paper on bismuth compounds in *Chem. Soc. Journal*, by Muir, Hoffmeister, and Robbs, the new salts bismuth fluoride (BiF_3) and bismuth oxyfluoride (BiOF) are described. The former is the more stable of the halogen compounds of bismuth: it is not decomposed by water, and is scarcely changed at a red heat in air.

PROF. BEILSTEIN, who has recently studied the various substances used for disinfection, arrives, in a communication made to the St. Petersburg Technical Society, at the following conclusions:—Sulphuric acid would be the best disinfectant if it did not destroy the sides of the tanks; the use of lime and of salts of lime ought to be completely renounced, as they but temporarily destroy bacteria, and under some circumstances may contribute to their development; nor does sulphate of iron, even in a solution of 15 per cent., ultimately destroy bacteria, as they revive when put into a convenient medium. Therefore Prof. Beilstein recommends sulphate of aluminium, which is used in paper and printed-cotton manufactures. The best means for providing it is to make a mixture of red clay with 4 per cent. of sulphuric acid, and to add to this mixture some carbolic acid for destroying the smell of the matter which is to be disinfected.

ACTION OF AN INTERMITTENT BEAM OF RADIANT HEAT UPON GASEOUS MATTER[1]

THE Royal Society has already done me the honour of publishing a long series of memoirs on the interaction of radiant heat and gaseous matter. These memoirs did not escape criticism. Distinguished men, among whom the late Prof. Magnus and the late Prof. Buff may be more specially mentioned, examined my experiments, and arrived at results different from mine. Living workers of merit have also taken up the question, the latest of whom,[2] while justly recognising the extreme difficulty of the subject, and while verifying, so far as their experiments reach, what I had published regarding dry gases, find me to have fallen into what they consider grave errors in my treatment of vapours.

None of these investigators appear to me to have realised the true strength of my position in its relation to the objects I had in view. Occupied for the most part with details, they have failed to recognise the stringency of my work as a whole, and have not taken into account the independent support rendered by the various parts of the investigation to each other. They thus ignore verifications, both general and special, which are to me of conclusive force. Nevertheless, thinking it due to them and me to submit the questions at issue to a fresh examination, I resumed some time ago the threads of the inquiry. The results shall in due time be communicated to the Royal Society; but meanwhile I would ask permission to bring to the notice of the Fellows a novel mode of testing the relations of radiant heat to gaseous matter, whereby singularly instructive effects have been obtained.

After working for some time with the thermopile and galvano-

[1] Paper read at the Royal Society, January 13, by Prof. Tyndall, F.R.S

[2] Lecher and Pernter, *Philosophical Magazine*, January, 1881; *Sitzb. der k. Akad. der Wissensch. in Wien*, July, 1880.

meter, it occurred to me several weeks ago that the results thus obtained might be checked by a more direct and simple form of experiment. Placing the gases and vapours in diathermanous bulbs, and exposing the bulbs to the action of radiant heat, the heat absorbed by different gases and vapours ought, I considered, to be rendered evident by ordinary expansion. I devised an apparatus with a view of testing this idea. But at this point, and before my proposed gas-thermometer was constructed, I became acquainted with the ingenious and original experiments of Mr. Graham Bell, wherein musical sounds are obtained through the action of an intermittent beam of light upon solid bodies.

From the first I entertained the opinion that these singular sounds were caused by rapid changes of temperature, producing corresponding changes of shape and volume in the bodies impinged upon by the beam. But if this be the case, and if gases and vapours really absorb radiant heat, they ought to produce sounds more intense than those obtainable from solids. I pictured every stroke of the beam responded to by a sudden expansion of the absorbent gas, and concluded that when the pulses thus excited followed each other with sufficient rapidity, a musical note must be the result. It seemed plain, moreover, that by this new method many of my previous results might be brought to an independent test. Highly diathermanous bodies, I reasoned, would produce faint sounds, while highly athermanous bodies would produce loud sounds; the strength of the sound being, in a sense, a measure of the absorption. The first experiment made with a view of testing this idea, was executed in the presence of Mr. Graham Bell[1]; and the result was in exact accordance with what I had foreseen.

The inquiry has been recently extended so as to embrace most of the gases and vapours employed in my former researches. My first source of rays was a Siemens' lamp connected with a dynamo-machine, worked by a gas-engine. A glass lens was used to concentrate the rays, and afterwards two lenses. By the first the rays were rendered parallel, while the second caused them to converge to a point about seven inches distant from the lens. A circle of sheet zinc provided first with radial slits and afterwards with teeth and interspaces cut through it, was mounted vertically on a whirling table, and caused to rotate rapidly across the beam near the focus. The passage of the slits produced the desired intermittence,[2] while a flask containing the gas or vapour to be examined received the shocks of the beam immediately behind the rotating disk. From the flask a tube of india-rubber, ending in a tapering one of ivory or boxwood, led to the ear, which was thus rendered keenly sensitive to any sound generated within the flask. Compared with the beautiful apparatus of Mr. Graham Bell, the arrangement here described is rude; it is, however, very effective.

With this arrangement the number of sounding gases and vapours was rapidly increased. But I was soon made aware that the glass lenses withdrew from the beam its most effectual rays. The silvered mirrors employed in my previous researches were therefore invoked; and with them, acting sometimes singly and sometimes as conjugate mirrors, the curious and striking results which I have now the honour to submit to the Society were obtained.

Sulphuric ether, formic ether, and acetic ether being placed in bulbous flasks, their vapours were soon diffused in the air above the liquid. On placing these flasks, whose bottoms only were covered by the liquid, behind the rotating disk, so that the intermittent beam passed through the vapour, loud musical tones were in each case obtained. These are known to be the most highly absorbent vapours which my experiments revealed. Chloroform and bisulphide of carbon, on the other hand, are known to be the least absorbent, the latter standing near the head of diathermanous vapours. The sounds extracted from these two substances were usually weak and sometimes barely audible, being more feeble with the bisulphide than with the chloroform. With regard to the vapours of amylene, iodide of ethyl, iodide of methyl and benzol, other things being equal, their power to produce musical tones appeared to be accurately expressed by their ability to absorb radiant heat.

It is the vapour, and not the liquid, that is effective in producing the sounds. Taking, for example, the bottles in which my volatile substances are habitually kept, I permitted the intermittent beam to impinge upon the liquid in each of them. No sound was in any case produced, while the moment the vapour-laden space above an active liquid was traversed by the beam, musical tones made themselves audible.

A rock-salt cell filled entirely with a volatile liquid and subjected to the intermittent beam produced no sound. This cell was circular and closed at the top. Once, while operating with a highly athermanous substance, a distinct musical note was heard. On examining the cell however a small bubble was found at its top. The bubble was less than a quarter of an inch in diameter, but still sufficient to produce audible sounds. When the cell was completely filled the sounds disappeared.

It is hardly necessary to state that the pitch of the note obtained in each case is determined by the velocity of rotation. It is the same as that produced by blowing against the rotating disk and allowing its slits to act like the perforations of a syren.

Thus, as regards vapours, prevision has been justified by experiment. I now turn to gases. A small flask, after having been heated in the spirit-lamp so as to detach all moisture from its sides, was carefully filled with dried air. Placed in the intermittent beam it yielded a musical note, but so feeble as to be heard only with attention. Dry oxygen and hydrogen behaved like dry air. This agrees with my former experiments, which assigned a hardly sensible absorption to these gases. When the dry air was displaced by carbonic acid, the sound was far louder than that obtained from any of the elementary gases. When the carbonic acid was displaced by nitrous oxide the sound was much more forcible still, and when the nitrous oxide was displaced by olefiant gas it gave birth to a musical note which, when the beam was in good condition and the bulb well chosen, seemed as loud as that of an ordinary organ-pipe. We have here the exact order in which my former experiments proved these gases to stand as absorbers of radiant heat. The amount of the absorption and the intensity of the sound go hand in hand.

In 1859 I proved gaseous ammonia to be extremely impervious to radiant heat. My interest in its deportment when subjected to this novel test was therefore great. Placing a small quantity of liquid ammonia in one of the flasks, and warming the liquid slightly, the intermittent beam was sent through the space above the liquid. A loud musical note was immediately produced. By the proper application of heat to a liquid the sounds may be always intensified. The ordinary temperature however suffices in all the cases thus far referred to.

In this relation the vapour of water was that which interested me most, and as I could not hope that at ordinary temperatures it existed in sufficient amount to produce audible tones, I heated a small quantity of water in a flask almost up to its boiling-point. Placed in the intermittent beam, I heard—I avow with delight—a powerful musical sound produced by the aqueous vapour.

Small wreaths of haze, produced by the partial condensation of the vapour in the upper and cooler air of the flask, were however visible in this experiment; and it was necessary to prove that this haze was not the cause of the sound. The flask was therefore heated by a spirit-flame beyond the temperature of boiling water. The closest scrutiny by a condensed beam of light then revealed no trace of cloudiness above the liquid. From the perfectly invisible vapour however the musical sound issued, if anything, more forcible than before. I placed the flask in cold water until its temperature was reduced from about 90° to 10° C., fully expecting that the sound would vanish at this temperature; but notwithstanding the tenuity of the vapour, the sound extracted from it was not only distinct but loud.

Three empty flasks filled with ordinary air were placed in a freezing mixture for a quarter of an hour. On being rapidly transferred to the intermittent beam, sounds much louder than those obtainable from dry air were produced.

Warming these flasks in the flame of a spirit-lamp until all visible humidity had been removed, and afterwards urging dried air through them, on being placed in the intermittent beam the sound in each case was found to have fallen almost to silence.

Sending, by means of a glass tube, a puff of breath from the lungs into a dried flask, the power of emitting sound was immediately restored.

[1] On November 29: see *Journal* of the Society of Telegraph Engineers, December 8, 1880.

[2] When the disk rotates the individual slits disappear, forming a hazy zone through which objects are visible. Throwing by the clean hand, or better still by white paper, the beam back upon the disk, it appears to stand still, the slits forming so many dark rectangles. The reason is obvious, but the experiment is a very beautiful one.

I may add that when I stand with open eyes in the flashing beam, at a definite velocity of recurrence, subjective colours of extraordinary gorgeousness are produced. With slower or quicker rates of rotation the colours disappear. The flashes also produce a giddiness sometimes intense enough to cause me to grasp the table to keep myself erect.

When, instead of breathing into a dry flask, the common air of the laboratory was urged through it, the sounds became immediately intensified. I was by no means prepared for the extraordinary delicacy of this new method of testing the athermancy and diathermancy of gases and vapours, and it cannot be otherwise than satisfactory to me to find that particular vapour, whose alleged deportment towards radiant heat has been most strenuously denied, affirming thus audibly its true character.

After what has been stated regarding aqueous vapour we are prepared for the fact that an exceedingly small percentage of any highly athermanous gas diffused in air suffices to exalt the sounds. An accidental observation will illustrate this point. A flask was filled with coal gas and held bottom upwards in the intermittent beam. The sounds produced were of a force corresponding to the known absorptive energy of coal-gas. The flask was then placed upright, with its mouth open upon a table, and permitted to remain there for nearly an hour. On being restored to the beam, the sounds produced were far louder than those which could be obtained from common air.[1]

Transferring a small flask or a test-tube from a cold place to the intermittent beam it is sometimes found to be practically silent for a moment, after which the sounds become distinctly audible. This I take to be due to the vaporisation by the calorific beam of the thin film of moisture adherent to the glass.

My previous experiments having satisfied me of the generality of the rule that volatile liquids and their vapours absorb the same rays, I thought it probable that the introduction of a thin layer of its liquid, even in the case of a most energetic vapour, would detach the effective rays, and thus quench the sounds. The experiment was made and the conclusion verified. A layer of water, formic ether, sulphuric ether, or acetic ether one-eighth of an inch in thickness rendered the transmitted beam powerless to produce any musical sound. These liquids being transparent to light, the efficient rays which they intercepted must have been those of obscure heat.

A layer of bisulphide of carbon about ten times the thickness of the transparent layers just referred to, and rendered opaque to light by dissolved iodine, was interposed in the path of the intermittent beam. It produced hardly any diminution of the sounds of the more active vapours—a further proof that it is the invisible heat rays, to which the solution of iodine is so eminently transparent, that are here effectual.

Converting one of the small flasks used in the foregoing experiments into a thermometer bulb, and filling it with various gases in succession, it was found that with those gases which yielded a feeble sound, the displacement of a thermometric column associated with the bulb was slow and feeble, while with those gases which yielded loud sounds the displacement was prompt and forcible.

Further Experiments.—Since the handing in of the foregoing note, on January 3, the experiments have been pushed forward; augmented acquaintance with the subject serving only to confirm my estimate of its interest and importance.

All the results described in my first note have been obtained in a very energetic form with a battery of sixty Grove's cells.

On January 4 I chose for my source of rays a powerful lime-light, which, when sufficient care is taken to prevent the pitting of the cylinder, works with admirable steadiness and without any noise. I also changed my mirror for one of shorter focus, which permitted a nearer approach to the source of rays. Tested with this new reflector the stronger vapours rose remarkably in sounding power.

Improved manipulation was, I considered, sure to extract sounds from rays of much more moderate intensity than those of the lime-light. For this light, therefore, a common candle flame was substituted. Received and thrown back by the mirror, the radiant heat of the candle produced audible tones in all the stronger vapours.

Abandoning the mirror and bringing the candle close to the rotating disk, its direct rays produced audible sounds.

A red-hot coal, taken from the fire and held close to the rotating disk, produced forcible sounds in a flask at the other side.

A red-hot poker, placed in the position previously occupied by the coal, produced strong sounds. Maintaining the flask in position behind the rotating disk, amusing alternations of sound and silence accompanied the alternate introduction and removal of the poker.

The temperature of the iron was then lowered till its heat just ceased to be visible. The intermittent invisible rays produced audible sounds.

The temperature was gradually lowered, being accompanied by a gradual and continuous diminution of the sound. When it ceased to be audible the temperature of the poker was found to be below that of boiling water.

As might be expected from the foregoing experiments an incandescent platinum spiral, with or without the mirror, produced musical sounds. When the battery power was reduced from ten cells to three the sounds, though enfeebled, were still distinct.

My neglect of aqueous vapour had led me for a time astray in 1859, but before publishing my results I had discovered my error. On the present occasion this omnipresent substance had also to be reckoned with. Fourteen flasks of various sizes, with their bottoms covered with a little sulphuric acid, were closed with ordinary corks and permitted to remain in the laboratory from December 23 to January 4. Tested on the latter day with the intermittent beam, half of them emitted feeble sounds, but half were silent. The sounds were undoubtedly due, not to dry air, but to traces of aqueous vapour.

An ordinary bottle containing sulphuric acid for laboratory purposes, being connected with the ear and placed in the intermittent beam, emitted a faint, but distinct, musical sound. This bottle had been opened two or three times during the day, its dryness being thus vitiated by the mixture of a small quantity of common air. A second similar bottle, in which sulphuric acid had stood undisturbed for some days, was placed in the beam: the dry air above the liquid proved absolutely silent.

On the evening of January 7 Prof. Dewar handed me four flasks treated in the following manner:—Into one was poured a small quantity of strong sulphuric acid; into another a small quantity of Nordhausen sulphuric acid; in a third were placed some fragments of fused chloride of calcium; while the fourth contained a small quantity of phosphoric anhydride. They were closed with well-fitting india-rubber stoppers, and permitted to remain undisturbed throughout the night. Tested after twelve hours, each of them emitted a feeble sound, the flask last-mentioned being the strongest. Tested again six hours later, the sound had disappeared from three of the flasks, that containing the phosphoric anhydride alone remaining musical.

Breathing into a flask partially filled with sulphuric acid instantly restores the sounding power, which continues for a considerable time. The wetting of the interior surface of the flask with the sulphuric acid always enfeebles, and sometimes destroys, the sound.

A bulb less than a cubic inch in volume, and containing a little water lowered to the temperature of melting ice, produces very distinct sounds. Warming the water in the flame of a spirit lamp, the sound becomes greatly augmented in strength. At the boiling temperature the sound emitted by this small bulb [1] is of extraordinary intensity.

These results are in accord with those obtained by me nearly nineteen years ago, both in reference to air and to aqueous vapour. They are in utter disaccord with those obtained by other experimenters, who have ascribed a high absorption to air and none to aqueous vapour.

The action of aqueous vapour being thus revealed, the necessity of thoroughly drying the flasks when testing other substances becomes obvious. The following plan has been found effective:—Each flask is first heated in the flame of a spirit-lamp till every visible trace of internal moisture has disappeared, and it is afterwards raised to a temperature of about 400° C. While the glass is still hot a glass tube is introduced into it, and air freed from carbonic acid by caustic potash, and from aqueous vapour by sulphuric acid, is urged through the flask until it is cool. Connected with the ear-tube, and exposed immediately to the intermittent beam, the attention of the ear, if I may use the term, is converged upon the flask. When the experiment is carefully made, dry air proves as incompetent to produce sound as to absorb radiant heat.

In 1868 I determined the absorptions of a great number of liquids whose vapours I did not examine. My experiments having amply proved the parallelism of liquid and vaporous absorption, I held undoubtingly twelve years ago that the vapour of cyanide of ethyl and of acetic acid would prove powerfully absorbent. This conclusion is now easily tested. A small

[1] The method here described is, I doubt not, applicable to the detection of extremely small quantities of fire-damp in mines.

[1] In such bulbs even bisulphide of carbon vapour may be so nursed as to produce sounds of considerable strength.

quantity of either of these substances, placed in a bulb a cubic inch in volume, warmed, and exposed to the intermittent beam, emits a sound of extraordinary power.

I also tried to extract sounds from perfumes, which I had proved in 1861 to be absorbers of radiant heat. I limit myself here to the vapours of pachouli and cassia, the former exercising a measured absorption of 30, and the latter an absorption of 109. Placed in dried flasks, and slightly warmed, sounds were obtained from both these substances, but the sound of cassia was much louder than that of pachouli.

Many years ago I had proved tetrachloride of carbon to be highly diathermanous. Its sounding power is as feeble as its absorbent power.

In relation to colliery explosions, the deportment of marsh-gas was of special interest. Prof. Dewar was good enough to furnish me with a pure sample of this gas. The sounds produced by it, when exposed to the intermittent beam, were very powerful.

Chloride of methyl, a liquid which boils at the ordinary temperature of the air, was poured into a small flask, and permitted to displace the air within it. Exposed to the intermittent beam, its sound was similar in power to that of marsh-gas.

The specific gravity of marsh-gas being about half that of air, it might be expected that the flask containing it, when left open and erect, would soon get rid of its contents. This however is not the case. After a considerable interval the film of this gas clinging to the interior surface of the flask was able to produce sounds of great power.

A small quantity of liquid bromine being poured into a well-dried flask, the brown vapour rapidly diffused itself in the air above the liquid. Placed in the intermittent beam, a somewhat forcible sound was produced. This might seem to militate against my former experiments, which assigned a very low absorptive power to bromine vapour. But my former experiments on this vapour were conducted with obscure heat; whereas in the present instance I had to deal with the radiation from incandescent lime, whose heat is in part luminous. Now the colour of the bromine vapour proves it to be an energetic absorber of the luminous rays; and to them, when suddenly converted into thermometric heat in the body of the vapour, I thought the sounds might be due.

Between the flask containing the bromine and the rotating disk I therefore placed an empty glass cell: the sounds continued. I then filled the cell with transparent bisulphide of carbon: the sounds still continued. For the transparent bisulphide I then substituted the same liquid saturated with dissolved iodine. This solution cut off the light, while allowing the rays of heat free transmission: the sounds were immediately stilled.

Iodine vaporised by heat in a small flask yielded a forcible sound, which was not sensibly affected by the interposition of transparent bisulphide of carbon, but which was completely quelled by the iodine solution. It might indeed have been foreseen that the rays transmitted by the iodine as a liquid would also be transmitted by its vapour, and thus fail to be converted into sound.[1]

To complete the argument:—While the flask containing the bromine vapour was sounding in the intermittent beam, a strong solution of alum was interposed between it and the rotating disk. There was no sensible abatement of the sounds with either bromine or iodine vapour.

In these experiments the rays from the lime-light were converged to a point a little beyond the rotating disk. In the next experiment they were rendered parallel by the mirror, and afterwards rendered convergent by a lens of ice. At the focus of the ice-lens the sounds were extracted from both bromine and iodine vapour. Sounds were also produced after the beam had been sent through the alum solution and the ice-lens conjointly.

With a very rude arrangement I have been able to hear the sounds of the more active vapours at a distance of 100 feet from the source of rays.

Several vapours other than those mentioned in this abstract have been examined, and sounds obtained from all of them. The vapours of all compound liquids will, I doubt not, be found sonorous in the intermittent beam. And, as I question whether there is an absolutely diathermanous substance in nature, I think it probable that even the vapours of elementary bodies, including the elementary gases, when more strictly examined, will be found capable of producing sounds.

[1] I intentionally use this phraseology.

INTERESTING NEW CRINOIDS

In the *Memoirs* of the Swiss Palæontological Society for 1880 Prof. P. de Loriol has recently described a remarkable new Crinoid which he refers to the little known genus *Thiolliericrinus*, Étallon, under the name of *T. ribeiroi*. It occurs in the Upper Jurassic beds of Engenheiro, in Portugal. The calyx, like that of most Jurassic *Comatulæ*, has five small prismatic basals attached to the under surface of the radials. But the centro-dorsal piece on which the calyx rests is not entirely separated from the lower part of the stem, as is the case in the *Comatulæ*, though it resembles that of a *Comatula* in bearing cirrhi.

Thiolliericrinus was a stalked Crinoid that never developed beyond the stage at which cirrhi appear on the enlarged uppermost stem-joint of the stalked larva of *Comatula*. The under-face of the centrodorsal and the terminal faces of the other stem-joints resemble those of the *Comatula* larva and also of *Bourgueticrinus* and *Rhizocrinus* in their oval shape and in the presence of transverse ridges which are in different planes at the two ends of each joint. *Thiolliericrinus* therefore is a permanent larval form, and furnishes an intermediate stage between the stalked *Bourgueticrinus* and the free *Comatula*. The top stem-joint of the former bears no cirrhi, as it does in *Thiolliericrinus* and in *Comatula*; while in the latter it develops cirrhi, and unites closely with the calyx, separating from the rest of the larval stem on which it was previously fixed.

Another form of considerable morphological interest, from its occupying an intermediate position between two well-defined genera, has been lately described by Mr. P. H. Carpenter under the name of *Mesocrinus*. The stem-joints are of the type already mentioned as characteristic of *Bourgueticrinus*, having oval faces marked by transverse ridges in different planes. But the upper stem-joint is not enlarged as it is in *Bourgueticrinus* and in the *Apiocrinidæ* generally, while the form of the calyx recalls that of the *Pentacrinidæ*. It consists of five radials with well-developed articular faces, resting on five basals which form a complete ring as in the recent *Pentacrinus Wyville-Thomsoni*, from 800 fathoms in the Atlantic off the coast of Portugal.

Broadly speaking, therefore, *Mesocrinus* combines the stem of *Bourgueticrinus* with the calyx of *Pentacrinus*, or rather of *Cainocrinus*, as Prof. de Loriol prefers to call that section of the *Pentacrinus* type in which the basal ring is closed. *Mesocrinus* is an Upper Cretaceous genus, one species occurring in the "Plänerkalk" of Streben in Saxony, while another and larger one was found in the "Mucronaten Kreide" of Southern Sweden.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Oxford.—In consequence of the unsatisfactory state of many of the lodging-houses in Oxford, in respect of their sanitary arrangements, a proposal will be brought before Congregation on March 1 "to make better provision for the supervision of lodging-houses." One of the delegates for licensing lodgings will be stipendiary, and it will be his duty to inspect every dwelling-house proposed for this use and to satisfy himself of its sanitary fitness. He shall have the assistance of a sanitary inspector, and shall have proctorial authority over members of the University in his character of inspector.

A special statute will also be proposed authorising the present delegates of lodging-houses to spend whatever sum they may think necessary on a general inspection of lodging-houses during the present year.

There will be holden at Christ Church on Saturday, March 12, an election to at least one Mathematical Junior Studentship, and at least one in Natural Science, tenable for five years from the day of election. They will be of the annual value either (1) of 100*l.* (including an allowance for room rent) if the Governing Body shall so determine; or (2) of 85*l.* (also including an allowance for room rent), which may be raised to the larger sum above named after the completion of one year's residence, if the Governing Body shall so determine. Candidates for the Mathematical Studentships and candidates for the Natural Science Studentships who offer mathematics will call upon the Dean on Monday, February 28, between 12.30 and 1.30 p.m.; candidates for the Natural Science Studentships who do not offer mathematics, on March 2, between 12.30 and 1.30 p.m. All must produce certificates both of the day of their birth and of good character. The examinations will follow in each case at