insanity, many have a tendency to promote the most perfect mental and physical development.

If the Alienist would solve the problem attending the increase of cases of insanity, we would direct him to other sources of the evil than that of civilization; let him probe the open and hidden vices of great cities; let him calculate the effect of the indiscriminate use of alcoholic liquors and the pernicious abuse of potent drugs. We regard opium, tobacco, chloral and sewer gas as some of the offending agents which weaken and debilitate the mental powers, rather than the mild educational cause of our public schools or the attending circumstances of student-life.

Dr. Jewell himself admits the destructive effects of these agents upon the nervous system, but they are classed as due to the influence of civilization. This we think an error, as they are connected with vices of a debased life; and although insanity may be on the increase, we consider it is far from conclusive that to civilization we should attribute the primary cause.

SCIENTIFIC SOCIETIES IN WASHINGTON, D. C.

THE BIOLOGICAL SOCIETY.—Three papers were read at the last meeting, Friday, Feb. 25, as follows: A Description of Pronuba yuccasella, by Prof. C. V. Riley; The Hall Collection of Fossils from New York, by Prof. C. A. White; and Suctorial Prehension in the Animal Kingdom, by Mr. Smiley. Professor Riley's paper was a revision of his communications before the American Association at St. Louis and in other places, concerning a moth, the *Pronuba yuccasella*, which not only deposits its eggs in the capsules of the Yucca, but which is also indispensable to the fertilization of the ovaries of that plant. It was remarked by Mr. Lester F. Ward, in commenting upon the paper, that we have here the most wonderful example of commensualism. Professor White is in charge of the duplicate set from the Hall Collection of Fossils sent to the National Museum. His remarks were a brief description of them as they now appear. There are about 1500 entries, and they represent nearly all the types in the Collection of the American Museum. Mr. Smiley's paper was a description of suctorial organs in the various divisions of the animal kingdom. These organs have in different circumstances, three functions, locomotion, anchoring and the seizure of prey. The author has bestowed a great deal of care on his communication and brought together a valuable mass of material.

THE ANTHROPOLOGICAL SOCIETY.—The Society met in the main hall of the National Medical College, Major J. W. Powell in the chair. The following papers were read: Amphibious Aborigines of Alaska, by Ivan Petroff; The Evolution of Marriage Ceremonies and Their Import, by Dr. A. F. A. King. Mr. Petroff described his experience among the shore Innuit population of Alaska, from the lower peninsula north to the Yukon mouth. There is water and marsh, mud and swamp everywhere, and the heavens swell the mass by their contribution of fog, rain, snow and sleet. The natives are enveloped in this watery environment the year round and thrive upon it. They even drink enormous quantities of it, not excepting the salt water of the bays and fiords, in their long fishing journeys, Doctor King's paper was an argument to prove that the progress of civilization had the tendency to set aside the laws of sexual relations which exist in a state of nature, such as the survival of the fittest, the observance of natural periods, and sexual selection. The paper was discusssed by Major Powell and Mr. Ward.

ACTION OF AN INTERMITTENT BEAM OF RADIANT HEAT UPON GASEOUS MATTER.*

BY JOHN TYNDALL, F. R. S.

The Royal Society has already done me the honor 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 Professor Magnus and the late Professor 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,† while justly recognizing 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 vapors.

None of these investigators appear to me to have realized 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 recognize 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 galvanometer, 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 vapors in diathermanous bulbs, and exposing the bulbs to the action of radiant heat, the heat absorbed by different gases and vapors 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 vapors 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;‡ and the result was in exact accordance with what I had foreseen.

The inquiry has been recently extended so as to em-

*Proceedings of the Royal Society.

† MM. Lecher and Pernter, "Philosophical Magazine," January, 1881. "Sitzb. der K. Akad. der Wissensch. in Wien," July, 1880.

‡On the 29th of November: see "Journal of the Society of Telegraph Engineers," December 8, 1880.

brace most of the gases and vapors 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,* while a flask containing the gas or vapor to be examined received the shocks of the beam immediately behind the rotating disc. From the flask a tube of india-rubber, ending in a tapering one of ivory or box wood, 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, effective.

With this arrangement the number of sounding gases and vapors was rapidly increased. But I was soon made aware that the glass lenses withdrew from the beam its 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 honor to submit to society were obtained.

Sulphuric ether, formic ether, and acetic ether being placed in bulbous flasks,† their vapors were soon diffused in the air above the liquid. On placing these flasks, whose bottoms only were covered by the liquid, behind the rotating disc, so that the intermittent beam passed through the vapor, loud musical tones were in each case obtained. These are known to be the most highly absorbent vapors 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 vapors. 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 vapors 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 vapor, 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 vapor-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 disc and allowing its slits to act like the perforations of a syren.

Thus, as regards vapors, 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 absorpti n and the intensity of the sound go hand in hand.

A soap bubble blown with nitrous oxide, or olefiant gas, and exposed to the intermittent beam produced no sound, no matter how its size might be varied. The pulses obviously expended themselves upon the flexible envelope, which transferred them to the air outside.

But a film thus impressionable to impulses on its interior surface, must prove at least equally sensible to sonorous waves impinging on it from without. Hence, I inferred, the eminent suitability of soap bubbles for sound lenses. Placing a "sensitive flame" some feet distant from a small sounding reed, the pressure was so arranged that the flame burnt tranquilly. A bubble of nitrous oxide (sp. gr. 1·527) was then blown, and placed in front of the reed. The flame immediately fell and roared, and continued agitated as long as the lens remained in position. A pendulous motion could be imparted to the bubble, so as to cause it to pass to and fro in front of the reed. The flame responded, by alternately roaring and becoming tranquil, to every swing of the bubble. Nitrous oxide is far better for this experiment than carbonic acid, which speedily ruins its envelope.

The pressure was altered so as to throw the flame, when the reed sounded, into violent agitation. A bubble blown with hydrogen (sp. gr. 0·069) being placed in front of the reed, the flame was immediately stilled. The ear answers instead of the flame.

In 1839, 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 vapor 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 intermitten beam, I heard—I avow with delight

* When the disc 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 disc, it appears to stand still, the slips 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 colors of extraordinary gorgeousness are produced. With slower or quicker rates of rotation the colors disappear. The flashes also produce a giddiness, sometimes intense enough to cause me to grasp the table to keep myself erect.

† I have employed flasks measuring from 8 inches to ¾ths of an inch in diameter. The smallest flask, which had a stem with a bore of about ⅛th of an inch in diameter, yielded better effects than the largest. Flasks from 2 to 3 inches in diameter yield good results. Ordinary test-tubes also answer well.

* With conjugate mirrors the sounds with olefiant gas are readily obtained at a distance of twenty yards from the lamp. I hope to be able to make a candle flame effective in these experiments.

—a powerful musical sound produced by the aqueous vapor.

Small wreaths of haze, produced by the partial condensation of the vapor 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 vapor, 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 not withstanding the tenuity of the vapor, 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 has been removed, and afterwards urging dried air through them, on being placed in the intermittent beam the sotum 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.

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 vapors, and it cannot be otherwise than satisfactory to me to find that particular vapor, whose alleged deportment towards radiant heat has been most strenuously denied, affirming thus audibly its true character.

After what has been stated regarding aqueous vapor, 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.

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 andtheir vapors 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 vapor, 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, ⅛th 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 vapors—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.

Received January 10, 1881.

FURTHER EXPERIMENTS.

Since the handing in of the foregoing note, on the 3rd of January, 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 the 4th of January 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 vapors 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 vapors.

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

A red-hot coal, taken from the fire and held close to the rotating disc 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 disc, 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 vapor 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 the 23d of December to the 4th of January. 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 vapor.

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 the 7th, professor 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 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* 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 vapor. They are in utter disaccord with those obtained by other experimenters, who have ascribed a high absorption to air and none to aqueous vapor.

The action of aqueous vapor 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 flask is still hot, a glass tube is introduced into it and air freed from carbonic acid by caustic potash, and from aqueous vapor 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 vapors I did not examine. My experiments having amply proved the parallelism of liquid and vaporous absorption, I held undoubtingly twelve years ago that the vapor of cyanide of ethyl and of acetic acid would prove powerfully absorbent. This conclusion is now easily tested. A small 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 vapors of patchouli 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 patchouli.

* In such bulbs even bisulphide of carbon vapor may be so nursed as to produce sounds of considerable strength.

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. Professor 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 vapor 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 vapor. But my former experiments on this vapor 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 color of the bromine vapor 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 vapor, I thought the sounds might be due.

Between the flash containing the bromine and the rotating disc 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 vapor, and thus fail to be converted into sound.*

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

In these experiments the rays from the lime-light were converged to a point a little beyond the rotating disc. 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 vapor. 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 vapors at a distance of 100 feet from the source of rays.

Several vapors other than those mentioned in this abstract have been examined, and sounds obtained from all of them. The vapors 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

* I intentionally use this phraseology.

even the vapors of elementary bodies, including the elementary gases, when more strictly examined, will be found capable of producing sounds.

THE UNITY OF NATURE.

By the Duke of Argyll.

VI.

(*Continued from page* 103.)

ON THE MORAL CHARACTER OF MAN, CONSIDERED IN THE LIGHT OF THE UNITY OF NATURE.

In dealing with this question, it is a comfort to remember that we are in possession of analogies deeply seated in the constitution and in the course of Nature. It is quite possible to assign to Intuition or to Instinct the place and rank which really belongs to it, and to assign also to what is called Experience the functions which are unquestionably its own. There is no sense or faculty of the mind which does not gain by education—not one which is independent of those processes of development which result from its contact with the external world. But neither is there any sense or faculty of the mind which starts unfurnished with some one or more of those intuitive perceptions with which all education and all development must begin. Just as every exercise of reason must be founded on certain axioms which are self-evident to the logical faculty, so all other exercises of the mind must start from the direct perception of some rudimentary truths. It would be strange indeed if the moral faculty were any exception to this fundamental law. This faculty in its higher conditions, such as we see it in the best men in the most highly civilized communities, may stand at an incalculable distance from its earliest and simplest condition, and still more from its lowest condition, such as we see it in the most degraded races of mankind. But this distance has been reached from some starting-point, and at that starting-point there must have been some simple acts or dispositions to which the sense of obligation was instinctively attached. And beyond all question this is the fact. All men do instinctively know what gives pleasure to themselves, and therefore also what gives pleasure to other men. Moreover, to a very large extent, the things which give them pleasure are the real needs of life, and the acquisition or enjoyment of these is not only useful but essential to the well-being or even to the very existence of the race. And as Man is a social animal by nature, with social instincts at least as innate as those of the Ant or the Beaver or the Bee, we may be sure that there were and are born with him all those intuitive perceptions and desires which are necessary to the growth and unfolding of his powers. And this we know to be the fact, not only as a doctrine founded on the unities of Nature, but as a matter of universal observation and experience. We know that without the Moral Sense Man could not fulfill the part which belongs to him in the world. It is as necessary in the earliest stages of the Family and of the Tribe, as it is in the latest developments of the State and of the Church. It is an element without which nothing can be done—without which no man could trust another, and, indeed, no man could trust himself. There is no bond of union among men—even the lowest and the worst—which does not involve and depend upon the sense of obligation. There is no kind of brotherhood or association for any purpose which could stand without it. As a matter of fact, therefore, and not at all as a matter of speculation, we know that the Moral Sense holds a high place as one of the necessary conditions in the development of Man's nature, in the improvement of his condition, and in the attainment of that place which may yet lie before him in the future of the world. There are other sentiments and desires, which, being as needful, are equally instinctive. Thus, the desire of communicating pleasure to others is one of the instincts which is as universal in Man as the desire of communicating knowledge. Both are indeed branches of the same stem—off-shoots from the same root. The acquisition of knowledge, to which we are stimulated by the instinctive affections of curiosity and of wonder, is one of the greatest of human pleasures, and the desire we have to communicate our knowledge to others is the great motive-force on which its progress and accumulation depend. The pleasure which all men take, when their dispositions are good, in sharing with others their own enjoyments, is another feature quite as marked and quite as innate in the character of Man. And if there is any course of action to which we do instinctively attach the sentiment of moral approbation, it is that course of action which assumes that our own desires, and our own estimates of good, and the standard by which we ought to judge of what is due to and is desired by others. The social instincts of our nature must, therefore, naturally and intuitively indicate benevolence as a virtuous, and malevolence as a vicious disposition; and, again, our knowledge of what is benevolent and what is malevolent is involved in our own instinctive sense of what to us is good, and of what to us is evil. It is quite true that this sense may be comparatively low or high, and consequently that the standard of obligation which is founded upon it may be elementary and nothing more. Those whose own desires are few and rude, and whose own estimates of good are very limited, must of course form an estimate correspondingly poor and scant of what is good for, and of what is desired by, others. But this exactly corresponds with the facts of human nature. This is precisely the variety of unity which its phenomena present. There are no men of sane mind in whom the Moral Sense does not exist; that is to say, there are no men who do not attach to some actions or other the sentiment of approval, and to some other actions the opposite sentiment of condemnation. On the other hand, the selection of the particular actions to which these different sentiments are severally attached is a selection immensely various; there being, however, this one common element in all—that the course of action to which men do by instinct attach the feeling of moral obligation, is that course of action which is animated by the feeling that their own desires and their own estimate of good is the standard by which they must judge of what is due by them to others, and by others to themselves.

And here we stand at the common point of departure from which diverge the two great antagonistic schools of ethical philosophy. On the other hand in the intuitive and elementary character which we have assigned to the sentiment of obligation, considered in itself, we have the fundamental position of that school which asserts an independent basis of morality; whilst, on the other hand, in the elementary truths which we have assigned to the Moral Sense as its self-evident apprehensions, we have a rule which corresponds, in one aspect at least, to the fundamental conception of the Utilitarian school. For the rule which connects the idea of obligation with conduct tending to the good of others, as tested by our own estimate of what is good for ourselves, is a rule which clearly brings the basis of morality into very close connection with the practical results of conduct. Accordingly, one of the ablest modern advocates of the Utilitarian system has declared that "in the golden rule of Jesus of Nazareth we read the complete spirit of the ethics of Utility. To do as you would be done by, and to love your neighbor as yourself, constitute the ideal perfection of Utilitarian morals."[2]

This may well seem a strange and almost a parodoxical result to those who have been accustomed to consider the Utilitarian theory not so much a low standard of morals, as an idea which is devoid altogether of that ele-

[2] J. S. Mill: "Utilitarianism," pp. 24, 25.