CONCLUSION.

I have thus ventured—I hope carefully, faithfully, and truthfully—to place before my brethren of the British Medical Association, and the medical professional generally, the bench, and the bar (for this is a question in which all classes are most deeply interested), the conclusions at which I have arrived, after thirty years extensive experience in hospital and private practice of railway and other similar accidents.

My conclusions I have endeavoured to support by cases, the like of which, had space been at my disposal, could have been repeated again and again.

The cases now published will, however, I trust, lead every physician and surgeon for the future to admit that, in forming an opinion as to the probable effects of a railway accident, nothing can be so likely to lead to error as the basing of that opinion on subjective symptoms only.

ACTION AND USE OF OXYGEN GAS, WHEN ADMINISTERED AS A THERAPEUTIC AGENT.

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It may, *in limine*, be taken for granted, that the old *dicta* of chemico-physiologists have within the last few years given way to the general admission that undiluted pure oxygen, as well as oxygen in large proportions to atmospheric air, can and does convey *even to the healthy* organism of man and animals a modified force or influence, varying according to individuality of human constitution or the class of animal experimented upon. The scientific gauntlet fabricated from the later experiments of Sir Humphrey Davy, with those of Allen and Pepys, more recently of Regnault and Reiset, and their representatives, has turned out but partially proved armour wherewith to fight the battle against the therapeutic value of oxygen exhibited beyond atmospheric proportions.

To endeavour to explain the *modus operandi* of oxygen gas as a therapeutic agent, is by no means the easy task which some recent supporters of and writers on the remedy would superficially assume—viz., superoxygenation as the *direct* effect of the administration of increased quantities of the gas. In fact, to assume this amounts to a practical admission of the correctness of the conclusions of the older experimenters, while ignoring those conclusions in treating disease. For my own part, I have for the last ten years felt the force of scientific reasoning, and have acknowledged that we must go much more deeply than the shallow idea of superoxygenation, or otherwise evade any attempt at explaining *modus operandi*—a most unsatisfactory alternative, in these days of advancing science. Placing oxygen simply on a par with medicines in general, we might certainly rest contented with a basis of *rational empiricism*; but, where the great life-supporting element is concerned, more accurate knowledge may be fairly anticipated sooner or later. Clinical experience may be ample; but, in the instance of a remedy like oxygen gas (demanding considerable experience in the selection of cases, unusual care in administration, and judgment in the use of cooperative remedies), clinical success depends too much upon the individual practitioner to be admitted without due caution as conclusive evidence.

In what follows, whenever the phrase “artificial oxygen” or “non-atmospheric oxygen” is used, it is intended to refer to oxygen gas chemically produced, and more or less diluted with ordinary air.

The *modus operandi* of oxygen gas, as a remedy in disease, involves three distinct considerations, in order to attain some approximation towards a correct apprehension:

1. The modified condition of the gas, as compared with that in atmospheric air.
 2. The constitutional predisposition, and the abnormal conditions incidentally existing in the organism of each patient.
 3. Cooperative measures which may assist or interfere with the remedial influence of the gas.
1. To the mind of any one who may have had a very moderate experience of oxygen as a therapeutic agent in suitable cases, there can hardly remain a doubt of the difference in effect between small doses of oxygen artificially prepared and the oxygen ordinarily breathed as the principal life-supporting constituent of atmospheric air; for, although we meet with plenty of cases where tolerably large doses are demanded, and where, consequently, it may be fairly argued that the *extra quantity* may have been the sole cause of the immediate and more or less continuous effect, yet abundance of evidence will from time to time present itself, to the eye of the clinical observer, of the absurdity of supposing materially increased oxygenation as the *direct* result of (say) two to six

pints of the gas added to from twenty-five to ninety pints of atmospheric air, and inhaled once in twenty-four hours. Still, however, certain superficial writers on the subject, who have latterly come forward advocating oxygen-inhalation, will harp upon the old string of burning up the superfluous carbonaceous matters, etc.; whereas such conception could only be correct on the supposition that the patient were kept in a largely superoxygenated atmosphere for several hours daily; while the fact is overlooked, that, were the extra quantity to be regarded as the criterion of benefit to be derived, the patient could usually, by a very little increase of exercise or natural inflation of the lungs, obtain all the advantage that a few additional pints of non-atmospheric oxygen could afford. Assuming, then, that benefit can arise from non-atmospheric oxygen in comparatively trifling proportion to atmospheric, and inhaled during a very limited period daily, such benefit can scarcely be explained, except by a modified condition of the gas employed. To such modification I formerly applied the practically significant but scientifically rather loose term, “quasi-nascent,” when the oxygen used was not actually nascent, yet for a time retained that special activity of its atoms to which I wished to draw attention as an essential point in its administration as a remedy in disease; while I added, that I had no confidence in oxygen which had been long released from combination, unless it had been kept in a largely compressed state, in suitable bottles.

Although the modified conditions of oxygen are still but partially known, yet the researches of Schönbein, Brodie, Tait and Andrews, Meissner, Soret, Clausius, Daubeny, Richardson, etc., have collectively so far cleared scientific view as to show that heat-carrying power and polarisation (with, perhaps, a varied arrangement) of the atoms of oxygen may be received as a satisfactory *general* hypothesis explanatory of the marked difference in action between oxygen artificially prepared and oxygen as it exists in the atmosphere.

As in the manifestation of electrical force, it would appear that active oxygen is never generated otherwise than in company with an opposite principle. As, on the application of heat to water (evaporation induced), the positive and negative principles, ozone and antozone so called, become developed, the former in the water, the latter in the vapour (Tobin); so, in employing heat in the artificial preparation of oxygen, ozone can be tested at the moment of liberation, but very slightly (and for a limited period only) in the reservoir after mere passage through the tubes of transit. Doubtless, the distinct polar conditions quickly give place to neutral oxygen; but it may be fairly surmised that this neutral oxygen will for a time remain in very active condition for motion and combination; and that this activity may be for a lengthened period preserved by condensing it, and may be further promoted by the expansion of the gas in the contact with atmospheric air, which takes place just prior to its use. It may even be surmised, with some probability of truth, that the mere mixture of the gas with the atmospheric air, by isolating and individualising its particles, may permit a freer therapeutic action than would otherwise obtain; just as the phosphate of lime in animal charcoal isolates and individualises the carbon therein, and thus renders the carbon-particles active in more directions of force than could possibly be, if they were closely posited.

Again, the recent chemical theories advanced to supersede the original electro-chemical theory of Berzelius—viz., those of Gerhardt, Laurent, etc.—accord to oxygen a di-atomicity, or (as Dr. Thudichum has recently suggested) dynamicity, which clearly points out a double plane of action, in which the gas may fairly be supposed to be capable of working out therapeutic results.

Dr. Richardson has ably impressed upon physiologists the fact that the agencies of heat and electricity have a very similar influence in rendering oxygen more active when freely exhibited to animals, and apparently infers the propriety (if not necessity) of the gas being warmed before inhalation in disease. He has also shown that oxygen gas, rendered inert for respiratory purposes by being breathed repeatedly, can be again made active by the electrical current passed through it. But it may be asked, Can its subjection to *heat* external to the body restore its activity? Certainly not, except through the direct (concentrated) rays of the sun; no more, indeed, than the heat within the lungs can preserve its activity after a certain time. Hence a force must have been existent in the atoms of the oxygen, affecting its heat-carrying power, and removed by the process of respiration; and electricity, being the result of solar action stored up and constantly available as an excitor, and under the influence of *motion*, can effect in the atoms of oxygen what artificial heat cannot. Thus heat and electricity, though analogous in result in some respects, must possess different planes of action in modifying the polar condition of the oxygen-atom; and the admission of such distinction will be observed to bear considerable practical import in attempting to explain the relations of heat and oxygen, in a pathological point of view, under the second head of our subject.

To ensure, then, the requisite energy of oxygen in small quantity as a

therapeutic agent, it should be either nascent, or carefully subjected to the electrical current immediately before employment, or properly condensed so as to be available for release, measurement, and administration, at a moment's notice; and this being premised leads us to the consideration of—

2. *Individual receptivity*, according to constitutional predisposition and pathological conditions. That the effect of oxygen gas upon a healthy person, or upon an animal, is a very imperfect analogue of its influence upon the subject of disease; and, further, that the amount of the gas administered does not necessarily represent the amount of benefit conferred; but that, on the contrary, a minimum dose will occasionally be found to afford a maximum of benefit surprising to the careful clinical observer,—are points of primary importance, which I may claim to have initiated. Not only are they important in a practical point of view, but in a suggestive capacity as regards *modus operandi*. Now, although the combination of the negative (or other polar) principle of the oxygen-atom with the polar principle of all other elementary atoms is, as a rule, clear and definite in inorganic, and approximately so in lower organic nature, yet, under the infinitely varied organic conditions of animal life, especially in man, we must have an equally infinite variation in the reception of the negative force associated with the oxygen-atoms by the positive force associated with the blood-corpuscles. As physiologists, we can scarcely, if at all, meet with two persons who can be absolutely asserted not to differ in the smallest degree in constitutional power of generating heat, musculo-nerve force, and blood-corpuscles, and consequently in the power of appropriating, for strength and vitality, the negative principle in the oxygen-atom. So great is the inherent vital power in some individuals—so quick and vigorous the assimilation of alimentary matters—that they can live in excellent health through their interior motility, assisted by a comparatively limited amount of food, air, and exercise. Contrast this with those who can scarcely “keep their blood in circulation”, and nutrition in tolerable activity for comfortable existence, without a large and regular supply of food, air, and exercise. It is true that each of these extremes and their intermediates, so long as they can and do maintain the *mens sana in corpore sano*—each receiving the requisite amount of atmospheric oxygen according to the natural demands of the organism—are often not very sensibly affected (some not at all) by the inhalation of large quantities of pure oxygen; although, notwithstanding, many even of these may be made to feel the influence of a small percentage added to atmospheric air, and inhaled under carefully detailed directions. (Some few constitutions, it should be noted here, are very sensitive to the influence of the gas under any circumstances.) Let, however, the healthy equilibrium of the organic economy be lost in some diseases, and the invalid will often experience most marked effects from what might have been a nullity in health. This contrast between different constitutions, and between health and disease, receives significant exemplification from a knowledge of the comparative effects upon animals; for Dr. Richardson has most ably demonstrated that the effects of oxygen upon them differ according to their activity of circulation and tendency to (so-called) inflammatory action; carnivorous animals being closely allied to birds in this respect, graminivorous representing the less inflammatory; while it has, of course, been long known by physiologists how little sensitive are the cold-blooded animals to the influence of oxygen.

If, then, it be granted as a principle, that there are at least to be found a small minority of persons in perfect health who can be made to feel, in greater or less degree, appreciable effects from inhaling oxygen gas; that comparative physiology strongly supports the correctness of such observations; and that pathology, through the medium of not a few careful observers, presents occasionally unquestionable evidence of *peculiar* rapidity and energy of action,—is it not reasonable to assume a *modus operandi* in disease mainly based upon individual receptivity, through variations in the interior power of generating and equably diffusing heat and musculo-nerve force? Without this as our *point d'appui*, indeed, it appears to me impossible to admit or form any rational idea of the frequently well-marked therapeutic action of a *very small* quantity of non-atmospheric oxygen, as contrasted with *any amount* of deep inflation of the lungs in ordinary atmospheric air, or “breathing mountain air”—words which have been so often sarcastically used by the prejudiced and ignorant, blindly assuming that neither can any difference exist in this instance between one organism and another, nor between oxygen from the laboratory and oxygen in the atmosphere.

Reference has been made to heat and electricity having a very similar influence in rendering oxygen more active when respired by animals. As a *physiological principle*, the fact is a very valuable one to be borne in mind; but any inference that it should be warmed before inhalation in disease appears by no means so satisfactory, for the question will at once arise to the sceptic, Does the effect, then, of a hot or warm atmo-

sphere upon an invalid presumed to require the therapeutic use of oxygen, approximate towards the effect of a small percentage of the gas added to atmospheric air, hot or cold? Certainly not. On the contrary, even a moderate (*à fortiori*, a very high) temperature will often be oppressive to the invalid; and, *without changing the temperature*, a small percentage of oxygen will *at once* relieve the difficulty, thus excluding the idea of mere sensible heat or the physical laws of expansion, contraction, and condensation of the atmospheric air itself. Indeed, it is occasionally found very advantageous to admit, at due intervals, diluted oxygen into the lungs at a very much lower temperature than the surrounding air which the patient is breathing. This, in juxtaposition with the well-known effects of the compressed air-bath in certain cases, naturally leads to reflection upon the law of diffusion of gases at different densities and temperatures, as suggestive of the more complete inflation of the distant cells, and quicker entrance of oxygen into the blood. Doubtless oxygen, in passing from a gaseous to a solid state, must yield caloric; but it does not follow that it will yield more active caloric by being first warmed. Such an idea would appear to involve some confusion of thought respecting latent and sensible heat (so called); and it seems more than probable that the latent heat stored up in the oxygen-atom may be thus prematurely lost. Warming the gas may be, indeed, desirable in some few cases of low vital power and collapse, simply as a precaution against the effects of temporary sensation of cold upon the lungs and system in general; but, on the other hand, just as one constitution can utilise atmospheric oxygen under ordinary circumstances far more quickly than another, so does a marked contrast exist between different conditions of the organism in the appropriation of artificial oxygen; the latent heat conveyed by the oxygen-atom being to a greater or less degree converted into energetic heat, and undergoing more or less rapid combination, exactly in proportion to the prior condition of the imponderable forces secreted within the body and conveyed by the nerves and blood-corpuscles. A febrile condition may exist; the quasi-febrile effects of a tropical heat may influence the oxygen without and the organism within; but such a condition, it need hardly be said, does not constitute increased vital power or more vigorous health, the reverse being too frequently illustrated in the unacclimatised European. It will be seen that these arguments directly point to the non-advisability of using warmed oxygen gas as a therapeutic in small proportions, since its low density would preclude it from giving out the same amount of energetic heat as gas at the ordinary temperature would do.

The effect of the electrical spark in renewing the vigour of oxygen previously respired suggests important reflection in viewing the *modus operandi* of oxygen. At a certain stage, after repeated respiration, all the imponderable force that the organism can abstract from the oxygen-atom appears to be exhausted, and more quickly by one condition of the organism than another; yet the gas can have its negative polarity restored. This affords an useful analogy to assist in forming a conception of the difference between atmospheric and more active oxygen in its effects on organic polarity, and inversely the effect of the latter (in different constitutions and diseases) upon the former. The necessary co-operation on the part of the positive force associated with the blood-corpuscles appears to bear close relation to their more or less energetic polarisation, or capacity for immediate polarisation, under the influence of the negative force in the oxygen atom; and this converts the latent heat of the oxygen-atom into active heat, *ceteris paribus*, with much greater rapidity in the case of oxygen just released from condensation or combination (when admitted into the lungs or stomach, and thus brought within its proper sphere of action), than occurs in the case of oxygen in ordinary conditions of settled expansion.

From foregoing remarks, the fallacy of oxygen being designated as always an exciting agent will be obvious. In my little work on the *Therapeutic Use of Oxygen* (1857), I earnestly impressed, in confutation of two directly conflicting opinions—1, that artificial oxygen is neither inert nor useless; 2, that it is not *per se* an excitor, but that it may be exciting or sedative, according to circumstances which I detailed. So many careful observers have since that time confirmed me, as to render it matter of astonishment how some few eminent physicians should still persist in sweepingly condemning it as “too exciting” an agent (*e. g.*) in pulmonary disease. Upon this point I shall have subsequently to comment in some pathological detail.

The oft-repeated old experiments demonstrating on the surface of the body itself, in congested excoriations and ulcerations, the action of oxygen gas locally applied, must here be referred to *en passant*, simply as completing the scientific chain of evidence towards a clear apprehension of the *modus operandi* of the gas when administered in disease. To Dr. Demarquay much credit is due for the confirmatory evidence rendered in this direction.

A *résumé* of conflicting physiological experiments, to which I for-

merly referred, would be superfluous here; for they have until recently tended to produce professional hostility towards, rather than support of oxygen in its pathological relations.

(To be concluded.)

PROGRESS OF MEDICAL SCIENCE.

ANATOMY, PHYSIOLOGY, AND PATHOLOGY.

INOCULATION OF TUBERCLE.—Dr. Bizzozero of Padua has made some researches on the inoculation of tubercle. Rabbits, inoculated by Professors Verga and Biffi of Milan, and Mantegazza of Pavia, having always exhibited pulmonary tubercles after a longer or shorter time, twelve of their lungs have been submitted by Dr. Bizzozero to microscopic examination. He agrees with preceding observers in remarking the existence of the characteristics of the grey granulation, whilst he clearly distinguishes all the analogous changes, especially the cheesy degeneration. Whilst endeavouring to determine the mode of the anatomical formation of the tubercle, after the examination of one hundred and fifty subjects, he arrived at the conclusion that in the rabbit, at least, this tuberculous proliferation takes place at the expense of the connective tissue and the epithelium; and, while granting, from the analogy of what goes on in the liver and the serous organs, that the connective tissue furnishes the essential elements, he proves that, at least, in this case, the epithelium goes a great way towards the formation of this new product. The contradictory opinions of different anatomists on this subject are in this way harmonised.—*Gazz. Lombard.*, No. 51, and *L'Union Médicale*, Feb. 1, 1868.

CONGENITAL MONORCHIA IN MAN.—Dr. Gruber, of St. Petersburg, in searching the literature of the last three hundred years, has found but twenty-two genuine cases of congenital deficiency of one testicle (monorchia). From a careful consideration of the details of these cases, and also of one observed by himself, he is enabled to assert that the subjects of this congenital deficiency are generally well-developed, free from other malformation and structural defects, and capable of arriving at an advanced age. The scrotum is usually well developed, and the testicle is more frequently absent on the right side than on the left. The seminal apparatus and genital organs on the opposite side rarely present any associated anomalies. The vesicula seminalis corresponding to the affected side is generally normal in size and form, and still acts as a secreting gland. No spermatozoa, however, have been found in the fluid taken from the vesicula seminalis on the side of the monorchia, although these bodies are generally present in great numbers in that of the opposite gland. The subject of a congenital monorchia, so long as the opposite testicle is well developed, is not incapable of procreating. In a case reported by Graaf, the man was the father of four children.—*Medizinische Jahrbücher*, hf. i, 1868.

MEDICINE.

ARSENICAL MEDICATION IN PULMONARY PHTHISIS.—At a late meeting of the Academy of Medicine of Paris, M. Moutard-Martin read a paper on the value of arsenical medication in the treatment of pulmonary phthisis. He arrived at the following conclusions. 1. Arsenical medication has a very decided effect on pulmonary phthisis. 2. Its action is more efficacious in slow consumption than in the former accompanied by fever. 3. Rapid consumption and granular phthisis are not at all modified by it. 4. In a great number of cases, even in advanced phthisis with hectic fever, the general condition of the patients is favourably affected—at least, for some time, which occasionally is of considerable duration. 5. The modifications of the local lesions only occur at a later date. 6. A certain number of cures may be attributed to arsenical medication; and this method would give more results, if the patients did not too soon consider themselves cured, and if they had more perseverance. 7. To be efficacious, the treatment must be continued for a long time. 8. The arsenic should be administered in very fractional doses. 9. The daily doses of arsenic should not be larger than two *centigrammes* (about one-third of a grain). 10. Arsenic agrees better with patients in the early stages than with those who have reached the stage of true consumption. The most evident action of arsenical medication is one which reconstitutes, and secondarily modifies, the pulmonary lesion. However, certain facts proving that arsenic possesses a direct action on the respiratory function, it may have one on the pulmonary tissue itself and on the tubercle.—*Gaz. des Hôpitaux*, 9 Janvier, 1868.

NEW INVENTIONS, &c.,

IN

MEDICINE, SURGERY, DIETETICS, AND THE ALLIED SCIENCES.

IMPROVED FORMS OF ARTIFICIAL NOSES.

WHEN disease, or (from dire necessity) the surgeon's scalpel, has removed from a fellow creature any limb or feature, it is a great boon to the sufferer when a really serviceable substitute is to be obtained.

Of all the losses which men can undergo, there is none perhaps which is so afflicting to the sensitiveness of the sufferer as the loss of a nose; and, as this calamity is much more frequent than might by the uninitiated be imagined, any one who succeeds in constructing an efficient substitute may expect, when the medical profession is made aware of it, to have plenty of cases to reward him for the anxious care and thought expended in its production.

We have been led to make these remarks from having seen some cases treated by Mr. H. J. Stump, of 53, Bolsover Street, Great Portland Street, whose *specialité* has hitherto been the construction of artificial legs, hands, and arms, in which walk he has been eminently successful, but to whose list is now added that of artificial noses.

Mr. Stump finds the sensitiveness of his patients an almost insuperable barrier to his exhibiting, even privately, any of his cases; but we have seen three cases, illustrated by the accompanying cuts, which but imperfectly show the improvements that he has wrought in them.

Fig. 1.

Drawing No. 1 represents one of three very similar cases; it is of a young lady who has suffered from hereditary syphilis, which, after raging between the nose and corner of the eye for many years, at last yielded to skilful medical treatment and healed, but leaving an orifice, leading into the head, one inch and a half high by five-eighths of an inch wide; and the contraction of the skin in healing has drawn down the sides of the orifice, the brow, the corner of the eyelid, and the bridge of the nose, giving the girl a frightful profile. Mr. Stump has covered the orifice and made up the bridge of the nose with a piece resting on the tip of the nose, which has remained intact, thereby doing away with the necessity of wearing a black riband tied round the face; it keeps the cold air out of the head, and, coloured to match the complexion of the surrounding parts, it is a vast improvement.

Drawing No. 2 represents a case of entire loss of the nose as a feature; it being, from a side view, perfectly gone.

Drawing No. 3 is of a case in which the disease was arrested after the