THESIS

FOR

M.D. Degree of Edinburgh

BY

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Part I.

Some Therapeutic Applications of Oxygen Gas.

From the "Oxygen Home."
2 Fitzroy Square,
London, W.
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INTRODUCTION.

At the close of the nineteenth Century, we find ourselves practically only on the threshold of the scientific world.

Much has been accomplished in the past; more has still to be accomplished in the future. The rapid advance of Medical Science during recent years has done much in elaborating our knowledge of various pathological conditions, in placing certain dubious facts on sounder bases, and in suggesting new ones.

Bacteriological Investigations have revealed to us the organismal origin of many forms of disease, and have thrown much light on certain obscure pathological conditions. That certain micro-organisms are responsible for the different forms of disease, is now a well established fact.

It has been demonstrated by experimental research on animals that these organisms either directly, or by the toxines they generate are responsible for the various retrograde changes in the healthy tissues.

A sound knowledge of Bacteriological methods is to the physician, what the Rontgen Ray apparatus is to the surgeon, a fairly accurate means of confirming the diagnosis in doubtful cases e.g. Diptheria, Typhoid Fever etc.
Having thus obtained one important factor—the Fons et origo of certain diseases, we next come to consider the other equally important factor—their treatment with a view to their ultimate cure.

It is not advisable to enter into the respective values of different forms of treatment here, excepting to briefly allude to them in passing.

Most practitioners use their own discretion in the matter of treatment, and utilise those drugs or that particular form of treatment by means of which they have achieved their best results.

In Surgery, as in Medicine, differences of opinion exist. In the former we have Antisepsis Versus Asepsis, in the latter we find that there are those who advocate the use of drugs largely in the treatment of disease, others again advocate the moderate use of Drugs, and leave the rest of the cure for Nature to accomplish.

My experience in these matters is extremely limited, so I am not in a position to discuss their respective merits or demerits. Judging, however, from the very excellent results obtained, by utilising some of the simpler measures, which Nature has placed at our disposal, I think we ought to inquire into these more fully and to put their applications to the test; before resorting to certain drugs, whose full Therapeutical values and actions we do not yet fully appreciate.

It has recently been demonstrated what important curative agents Heat, Light, and Air have shown themselves
to be— I allude to Finsen’s Phototherapy, Hœlländer’s Hot Air Treatment, and the open Air treatment of Phthisis.

We next come to the purport of this paper— Oxygen Gas, and I trust that the very satisfactory results achieved by its use in very bad cases; will fully justify its application in allied conditions, and that it may soon establish its place as one of Nature’s most powerful benefactors in Disease— and come to be recognised as one of the most powerful and at the same time harmless Therapeutical applications of modern times.
HISTORICAL RETROSPECT: - Mayow in 1674 recognised that the active constituent of air which supports combustion forms only part of the atmosphere, and that the same substance is present in Nitre, and is given off when Nitre is heated strongly. Mayow termed this gaseous constituent of air and Nitre "Spiritus Vitalis"; Spiritus Nitro-Aereum", and "Pabulum Igneo-Aereum". But it was just a century later before its actual discovery took place.

Priestley first obtained the Gas on August 1st, 1774, by heating Mercuric Oxide in a glass vessel by the heat of the Sun's Rays concentrated on the Oxide by means of a burning glass, and gave it the name "Dephlogisticated Air". The Gas was isolated independently, and almost simultaneously by the Swedish Chemist Scheele, who applied to it the term "Empyreal" or "Fire Air".

Condorcet soon after suggested the name "Vital Air". Lavoisier regarded it as an essential constituent of all acids, and hence gave it its present name Oxygen (from Oxus, acid, and Gennao- I form)

The latter discovery that Hydro-Chloric Acid and the other Halogen Acids contained no Oxygen showed that this substance is not necessarily present in Acids; but the name has been retained. The discovery of Oxygen was the means of leading Lavoisier to the theory of combustion.
PREPARATION OF OXYGEN GAS:— There are at least a dozen very substantial ways of preparing this important Gas; but the mention and detailed description of the various methods adopted for procuring this gas would occupy too much time and space, besides being superfluous in a paper of this nature.

One important way of preparing oxygen I shall just refer to—the reaction being especially interesting, because Priestley first obtained the gas by this means:—By heating red oxide of Mercury it splits up into vapour of Mercury (which condenses) and Oxygen:—\[2 \text{HgO} = 2 \text{Hg} + \text{O}_2\]

PROPERTIES OF OXYGEN GAS:— Oxygen is a colourless, tasteless, and inodorous gas of Sp. Gr. 1.1056 compared with air which is taken as 1.

It is sparingly soluble in water. The activity of Oxygen is increased greatly by increase of temperature, even at a high temperature, a trace of moisture is necessary for free oxidation.

Oxygen is the only gas capable of supporting respiration, and forms the life maintaining constituent of air. In the pure state it may be inhaled for a time with impunity, and acts as a mild tonic or exhilarant. But its long continued respiration is harmful, feverishness and weakness being produced, and it becomes poisonous if breathed under pressure.

A MEDICAL USE. It has been found that the admixture of small proportions (up to 6 or 7 p.c.) of oxygen with Nitrous Oxide during anaesthetising with that substance prevents
or reduces the tendency to convulsions experienced with pure Nitrous oxide, without reducing appreciably its anaesthetic power.

Oxygen though long regarded as a permanent gas was liquified in 1877 by Pictet at a pressure of 320 atmospheres at a temperature of -140°. He attributed to Liquid Oxygen a density near that of Water, about .9787. More recently Wroblewskiand Olszewski have worked, both conjointly, and independently on this subject, and have shown that the critical temperature of oxygen (i.e. the temperature of oxygen above which no amount of pressure will liquefy it) is -113 , the pressure needed to liquefy it at that temperature being 50 atmospheres *

Beddoes, Professor of Chemistry at Oxford, published a very interesting paper in 1789 entitled "Consideration of the Pictitious Airs". In this work he details a series of very interesting experiments, and he arrived at the following principal results.

1. Oxygen produces a remarkable power of resisting asphyxia. It appears that when the blood contains an unusual amount of oxygen, the animal is better able to support a deficiency of respirable air, or even the presence of an irrespirable Gas.
2. Animals which have respired oxygen resist longer the action of frigorigific mixtures.

* (Thorpes' Dictionary of applied Chemistry, p.p.82. 91.)
Beddoes established a “Pneumatic Institute” in which the therapeutic uses of different gases were ascertained. He enlisted the cooperation of Sir H. Davey, to the chemical part of the work, and of James Watt, the eminent Engineer, for the mechanical appliances used in the administration of the gas.

Probably a more brilliant triumvirate was never combined in the furtherance of a Scientific object. In this Institute obstinate ulcers, Leprosy, Spasms, Epilepsy, Chlorosis, Opium Poisoning, Continued Fever, Intermittent Fever, Headaches, etc. were successfully treated by inhalation of the gas, and not by local application.

Phthisis was not included in this list, as he framed the theory that in Phthisis there was a change, either in the constitution of the blood, or in the substance of the lung that favored the absorption of oxygen, which was therefore already present in excess; for this reason he considered oxygen absolutely contraindicated.

The labours of Beddoes did much towards establishing the true position of oxygen as a Therapeutic agent. He demonstrated that it was an agent capable of producing good effects in many cases not reached by ordinary means. It is very extraordinary that such satisfactory results as Beddoes obtained did not lead to a more general adoption of the treatment, with the exception of Hill and Thornton,
his contemporaries, scarcely any British Physician seems to have become interested in the matter, and it was allowed to die out with its original promoters.

While Beddoes was carrying on his observations in England, numerous experiments and observations were conducted in Germany by Girtanner, who following in the footsteps of Fourcrroy, gave arsenic dissolved in Nitric acid for a long range of complaints, under the impression that the solution imparted oxygen to the system. He obtained excellent results with oxygen in Intermittent Fever.

In Geneva Jurine and Odier took it up and established an Institute like Beddoes; but this was shortlived, and the whole subject of the Medicinal use of oxygen sank into oblivion.

In 1857 Dr. S.B.Birch, of London, issued his work on the Therapeutics of Oxygen. The Cases which he published are certainly very striking, and the results in his hand of the administration of the Gas, lead to some really marvellous results.

Various other works of minor importance have been written on this subject; but time and space prevent me from quoting them.
PERSONAL OBSERVATIONS RELATING TO THE SYMPTOMS & EFFECTS OF OXYGEN INHALATION.

1. GENERAL EFFECTS:— Patients inhaling Oxygen for lengthened periods experience various sensations, some patients feeling very easy and comfortable during the inhalation, others on the contrary feeling great discomfort, so much so, that the use of the Gas has to be temporarily suspended. Many of my patients state that they breathe much more freely under oxygen and experience a great sense of freedom about the chest, especially beneath the Sternum. Others complain of very severe supraorbital headache with a feeling of fullness in the head and throbbing. Some complain of lightheadedness, which may go on to Vertigo, which was very pronounced in one of the cases, and fearing some unpleasant complications the use of the Gas was stopped for three or four days.

2. HYPNOTIC ACTION:— Many of my patients get very drowsy on taking the Gas, and yawn repeatedly, some sleeping during the greater part of the day, and seem to be especially sleepy when they are not taking food, the gas seems to exert its full Hypnotic influence in these cases.

3. ACTION ON THE CIRCULATORY SYSTEM:— Oxygen acts as a Cardiac stimulant causing increased action of the heart at first, this soon, however, coming back to its normal state.
The pulse is sometimes accelerated, but more frequently remains unchanged, in cases of debility it is often reduced in frequency.

4. ACTION ON THE RESPIRATORY SYSTEM: — Oxygen inhalation does not seem to have any marked effects on the Respiratory System, as I have already stated, the breathing seems to be rather freer, giving rise to a feeling of warmth and comfort in the chest. The Respirations are quite regular and normal. Its action is very beneficial in cases of insufficient entrance of air into the lungs as in Dyspnoea orthopnoea etc, in which the patients are usually very cyanosed.

5. ACTION ON THE DIGESTIVE SYSTEM: — Many patients complain of a feeling of dryness of the mucosa of the mouth and pharynx during the inhalation. this is soon relieved by a drink of acidulated water. Oxygen has a marked effect on the patient’s appetite, stimulating it to a remarkable degree, one of my patients who always had a very small appetite, told me that since taking the Gas she feels as if she could eat almost anything. The gain in weight in this particular patient attests the fact that an increased amount of food is assimilated, during the taking of oxygen.

6. ACTION ON THE TEMPERATURE: — I trust that I shall be able in this paper to fully substantiate the claims of oxygen Gas as an Antipyretic agent in cases of high temperature. The temperatures of all the patients directly inhaling the gas at the Hospital are carefully recorded— these being
taken in the morning at 7 o'clock before they take the gas and recorded, then taken again and recorded at 7 P.M. before they have the Oxygen Inhalation stopped for the night. Most of the cases I shall describe have their Temperature Charts appended, so that the effects can be more readily studied. During my observations on the temperature, I have noticed that Oxygen acts by reducing the temperature considerably, this being especially marked in cases of high temperature. This was very beautifully brought out in one of our Pneumonia cases, where the patient had a temperature of 103.5° F. and after inhaling three cubic feet of oxygen it fell to 99° F. It very often brings a normal temperature slightly to the subnormal. This antipyretic use of the Gas being especially marked in cases of Pneumonia, or in cases of feverish headaches.

7. **ACTION ON MICRO-ORGANISMS**

1. Oxygen exercises a selective power in reference to micro-organisms, on wounds, ulcers, lupus, etc., causing some to grow larger and flourish, and causing others to grow smaller and in some cases to disappear altogether.

2. In cases where healing is progressing favorably, it has been found that the Staphylococeci, especially Staphylococeci Pyogenes albus & citreus are in great abundance and flourish. The greater the number of staphylococeci present, the more favorable the prognosis as to the ultimate cure of the diseased condition. Their presence in healing wounds
having led us to regard them as "Beneficent" or favourable micro-organisms. In badly healing ulcers, etc., it has been found that Streptococci in dysipelatous conditions and a series of Rod Bacilli and Diplococci in others predominate over the Staphylococci - these are regarded as "Malignant Organisms". Oxygen causes the Beneficent Organisms to grow larger, and causes them to be more easily stained by various staining reagents. The Staphylococci Aureus and Albus probably act in the ulcer or wound by absorbing poisoning matters, on which they live, their excreta again poisoning the wound; but not being sufficiently virulent are more readily oxidised and purified by the Oxygen, and the process of healing thus precipitated.

8. ACTION ON UNHEALTHY TISSUES: Oxygen exerts a stimulating action on unhealthy tissues, causing the pale unhealthy granulations to sprout and flourish, and allows the newly formed epidermis to grow in rapidly from the sides. At the same time it does not produce irritation of the denuded surface, as dressings immediately applied to the part would, especially if the dressing applied be saturated with Carbolic or corrosive Sublimate, which, however, diluted exerts a certain amount of irritation. Oxygen keeps the parts beautifully clean and sweet smelling, thus acting as a very powerful disinfectant and deodouriser. Its latter action was very well brought off in some cases of Atrophic Rhinitis, I treated by Oxygen, the ozoena with its heavy pungent, foul smelling odour entirely disappearing after a few applications.
I have been fortunate in seeing upwards of twenty cases of Lupus most successfully treated during the past year at Dr. George Stoker’s Private Hospital, 2, Fitzroy Square, London, W. This Institution has very aptly been called the “Oxygen Home,” as most of the cases there are treated either by the local or internal application of Oxygen Gas. As this mode of Treatment has only within recent years come to the knowledge of the profession, and as cases of very chronic ulcers, wounds, Eczema, Lupus and also very bad cases of Pneumonia have been very successfully treated by this means, I thought I was fully justified in devoting upwards of a year in carrying on research work in this interesting subject, and also a series of experiments on dogs under the direction of Prof. Vaughan Harley, of the University College, London.

I wish, in this Paper, to humbly submit to your notice the results obtained in my experiments, and also to fully report some of the cases treated at the Oxygen Home. Before describing the cases, I shall just briefly give the outline of the routine treatment adopted at the Hospital; the patient on admission has the Lupoid areas on the face carefully scrubbed with sterilized water and soft soap—then a sterilized water dressing is put on for the night, and the following day the patient is operated on under an anaesthetic, when the parts are most thoroughly scraped. Then a sterilized water dressing is again applied to the parts, and kept on for the rest of the day and night. The following day the Patient is ready for the Oxygen treatment.
(The Gas is applied to the parts by a specially made Mask which closely fits the parts on the face which it is intended to treat.) The Gas is at first applied considerably diluted (1/3 of oxygen to 7/8 of sterilized air) and as the patient is able to bear it, it is from time to time increased in strength.

Each patient receives a bag full of oxygen in the morning, which is connected by a tube with the mask on the face, and in this way the Gas is allowed to play on the unhealthy tissues all day, and removed at night when the sterilized water dressing is again applied. The Gas used at the Hospital is that prepared by Messrs. Brin, Manufacturers of Oxygen, and is, in my experience the best. We have a very ingenious apparatus for charging the bags with the desired proportions of Sterilized Air and Oxygen, the workings of which will be readily understood by reference to the appended diagram:
A = Cylinder of Brin's Oxygen.
B = Graduated Gasometer.
C = Apparatus for pumping in Air.
D = Wash bottle containing Potassium-Permanganate Solution.
E = Wash Bottle containing Lime Water.
F = Bag containing one cubic foot of Oxygen.
G = Moveable part of Gasometer moving upwards in direction indicated by arrow.

The following description will now be more easily understood.

Oxygen is let in from the Cylinder A till the moveable part of Gasometer registers 1/8 on the graduated scale painted along side of it—then tap of cylinder closed. Next Air is pumped in by C, passing through Wash Bottle D. and E so that by the time it gets to B. it is very thoroughly sterilized. The Gasometer is then filled with the Sterilized Air, so that at the end of operation it contains 1/3 Oxygen and 7/3 sterilized Air. The bag at F. is next filled and so replenished from time to time for bedside use. The Gas bag at F. holds 1 cubic foot and is sufficient for ten hours. The parts to which the Gas is applied, is enclosed in a specially constructed apparatus; for example, in a case of Ulcer or wound of the leg, the part is enclosed in a wooden box, with a window of glass at the top, through which the progress of the
ulcer may be watched without unnecessarily disturbing the part or patient, see diagram:

A = Glass window.
B = Tightly fitting waterproof which prevents air entering the apparatus.
C = Bag containing the gas.
D = Tube conveying the oxygen.

The temperature in the enclosure is kept at between 80° and 90° F. This is regulated by placing hot water bottles in the enclosures.

It is found that oxygen acts best in a warm moist atmosphere.
In cases of Lupus of the face the patient wears a specially constructed Mask, similar to that used for administering Ether. In cases of affections or injuries to the scalp, the patient wears an India rubber Cap, and the oxygen is conveyed into the Cap by a Tube:

--- RESUME OF THE VARIOUS MODES OF APPLYING THE GAS TO DIFFERENT PARTS OF THE BODY. WITH ILLUSTRATIONS. ---

(1) In cases of Head injury or disease of the Scalp, such as Favus and Ring worm etc., the gas is applied by a tightly fitting Cap connected with the bag by a Tube—the patient is able to go about, and if he feels well enough generally is able to engage in manual work.

(2) In cases of abrasions or diseased conditions of the face, such as Lupus etc., the Gas is applied to the part by specially constructed Masks, in the same way as above.
If disease on parts around the eye, a window of glass is let into the Mask, through which the patient can see.

In application to the Ear, an inlet Tube projects about 3/4 of an inch inside the Mask and thus the current of oxygen is directed into the external auditory Meatus, useful in cases of Eczema of these parts.

(3) In wounds or Ulcers on the Thorax, the Gas is applied in the same way, the mask being secured to the part by a strap around the body.

(4) In cases of Ozoena, the patient receives the Gas through the one nostril, the other being plugged with
cotton wool, breathing through the mouth, to avoid inhaling the Gas. The unhealthy crusts being previously removed by syringing with Alkaline Lotions.

In cases of Pneumonia, the pure Gas can be similarly applied, in this case the patient inhales the Gas.

N.B. In cases where Masks are used on the face or any part of the body, it is not desirable or necessary that they should be air tight. Ventilation is highly necessary. This is easily managed by the apparatus not fitting too closely to the skin surface, which allows the passage of oxygen and sterilized Air from within out; and being at a greater pressure, prevents entrance of impure air from without in.

Before entering on a description of the various cases, it will be of interest just very briefly to allude to how this very satisfactory form of treatment came into existence, and how the idea was suggested to Dr. Stoker, its able originator.
It was while serving on the several Ambulances in the Russo-Turkish and Zulu Wars, that he had an opportunity afforded of attending several bad wounds. It was especially during the Zulu wars that he was greatly impressed, for he noticed that the Zulus, being naturally averse to surgical operations, usually retired to the uplands with their wounded, where the air was pure and the sun warm and scorching. The wounds healed in a really marvellous manner. He attributed this partly to the warm dry air which retards the progress in the growth of the Streptococci, Staphylococci and Rod Bacilli, and thus greatly tends to retard the progress of pusformation and ulceration, and partly to the ozone in the air, which is usually most plentiful just after a thunder storm. To the above rapid cure and progress of ulcers in the natives of South Africa, I can fully testify, as having lived among them for upwards of twenty years and have seen some really wonderful cures of some really bad wounds and ulcers.

After these few preparatory remarks, I shall now go on to describe some of the cases of Lupus treated by Oxygen, and which have come under my notice during the past year.
CASE 1.

MARTHA WEEKLY. Age 20 Single.

Residing at = 8, Highbury Street, London, S.E.
Occupation = Domestic duties at home.
Admitted = November 9th. 1899
Discharged = January 15th. 1900

HISTORY:

(a) Family History: Parents both alive and well. There are five brothers and four sisters alive, all quite well and strong. The family originally consisted of fifteen. One sister of 16 and a brother of 13 died of consumption, four children died in infancy, cause not known. Patient has a comfortable home, but states her surroundings are very poor and dirty.

(b) History of Disease: She first noticed a small reddish spot at the corner of the left Ala Nasi, about ten years ago, that is when she was ten years of age. At first nothing was thought of it, but it gradually began to spread.

(c) Previous Treatment: Her mother became anxious and took her to the Waterloo Hospital, where the condition was diagnosed and attended to by Dr. Wakely. Patient was then admitted as an in patient for nine months. During this time the Lupus had involved the whole of the soft part of the left side of the nose. She was scraped immediately on admission, but without any marked effect—three months later again scraped but only temporarily relieved the condition. Soon after this it again broke out and spread
over the top of nose and to other side. Six weeks later she was again scraped, and had several more during the
four and a half months following. She left the Hospital and attended as an out patient for six months. Iodoform
and Boracic Ointments were applied locally, and Cod Liver Oil and Tonics administered internally, taking a light
diet of fish, milk and vegetables. She went home for a
year and three months, having nothing done for the face,
and resorting to an ordinary meat diet. The condition
during this time apparently remaining stationary. Just
about the end of this time the condition again broke out
and began spreading, giving rise to great irritability
at the spreading margins. Then she attended the Stamford
Street Skin Hospital as an out patient for two years,
using Ointments and Lotions checking the spread, but not
markedly improving the condition. She then went home for
a year and was treated by a local Doctor. On returning to
London, she spent several months at Gray's Inn Hospital,
and after that at King's College Hospital, where she at-
tended three years as an out patient, being treated with
Lotions, Unguents and several scrapings, but without any
marked effects. By this time the condition had involved
all the soft parts about the mouth, the chin, and upper part
of neck. In this condition she was admitted to the Oxygen
Home on the 9th November 1899.

(d) Present Treatment: When she was immediately scraped,
and her mouth which had previously contracted extremely
was at the same time enlarged by an operation. During the
rest of the day and night she had the parts enclosed in sterilized water dressings. Previous to the operation and immediately on admission, she was photographed, giving a very accurate idea of the extent of the Lupus.

On the morning of the 10th, she had the Oxygen applied to the face by means of a specially constructed mask. During the first few applications she experienced extreme burning and smarting of the scraped Lupoid areas under the influence of Oxygen. She also inhaled the Oxygen as the apparatus covered the nose and mouth completely. At first she had a nasty frontal headache, especially severe over both eyes. The inhalation of the Gas had a marked effect on the temperature, which was somewhat elevated after the scraping, and exerted its antipyretic action to full by reducing the temperature. The effect on the Pulse and Respiration were also noted. (See Temperature Chart).

After taking the Gas for three days all the symptoms disappeared and she then took it without any bad results.

On admission a Culture was made by taking scrapings with platinum needle from different parts of the face and inoculating several tubes of agar-agar. After leaving them in a hot bath at body temperature for forty-eight hours, the growth was then stained with Carbol-Fuchsin and mounted. This was examined microscopically by 1/12 lens and cedar Oil.

She left the Hospital completely cured on January 15th and before leaving a Culture was taken, which revealed the following, and at the same time she was photographed.
On Admission

On Discharge.

After operation on the Mouth
Lupus Vulgaris.

On Admission

(a) Diplococci.
(b) Rod Bacteria.
(c) A few colonies of Staphylococci.

Stained Carbol Fuchsin.

Shortly before Discharge.

Scraping taken with Platinum needle and Culture made in Agar-Agar.
Examined showing colonies of Staphylococci Pyogenes Citreus

Stained Carbol Fuchsin.

Temperature Chart.
Residing at - 106, Luton Road, Chatham.
Occupation - Music teacher.
Admitted - November 27th 1899
Discharged - 2nd. January 1900.

HISTORY.

(a) Family History. Father and Mother alive and well. Two sisters and one brother living, all quite well and strong. Lost three brothers and two sisters. A brother and a sister died of Typhoid Fever. One sister of consumption. One brother of Rheumatic Fever, another of Croup. Patient has a comfortable home and surroundings.

(b) HISTORY OF DISEASE: - About eight years ago patient had a very severe attack of measles, which left her very weak and run down in health, particularly affecting her eyesight especially that of the right eye. After the eruption had disappeared, a small, dry, scabby looking pimple persisted in the middle of right side of nose. This was very irritating; but she carefully refrained from scratching.

(c) PREVIOUS TREATMENT: - Patient then went to St. Bartholomew's Hospital, where condition was diagnosed and treated by scraping and application of Boracic Ointment locally, and Cod liver Oil internally. With the exception of a fortnight at Guy's Hospital, where she received similar treatment, she has regularly continued at Bartholomew's Hospital, up till the time she was admitted to the Oxygen Home.
(d) PRESENT TREATMENT:— On admission the condition had involved all the soft parts of the nose. She was scraped on the 30th November, under Ether, and on Friday morning had the Oxygen applied, experiencing the same sensations as those mentioned in the previous case.

In this case, as in the last, Cultures were taken a fortnight after entering the Hospital, and from time to time to see how the condition was progressing under the treatment.

Following are drawings of microscopic appearance of Culture on admission and on leaving.

Patient left on the 2nd of January completely cured.

The parts had cicatrised over completely and the surrounding tissues looked quite healthy and normal.

(See illustrations on page 28 & 29.)
On Admission.
27th November 1899

On Discharge.
2nd January, 1900.
On Admission

Culture of scraping from Nose taken and examined showing:
(a) Diplococci.
(b) Staphylococci.
(c) Rod Bacteria.

The above cultivation was made after the patient had been using Oxygen for nearly a fortnight - this probably accounting for the preponderance of the Staphylococci.

Stained Carbol Fuchsin.

Shortly before Discharge.

Culture taken and examined showing:
Pure growth Staphylococci
Pyogenes Albus

Stained Carbol Fuchsin.

Temperature Chart.
CASE 3. WALTER LEONARD HARMER: - Age 21, Single.
Residing at - 1, Peabody Buildings, Shadwell,
Occupation - Labourer.
Admitted - Nov. 21, 1899
Discharged - To be discharged shortly.

HISTORY:

(a) Family History: - Father died of Enteric Fever. Mother of Paralysis, and a brother in infancy of convulsions. His surroundings at home were not very satisfactory and his food was not always of the best. He is very moderate in his habits, does not drink and smokes very little.

(b) History of Disease: - Patient has never had any serious illness, and has never had any of the ailments of childhood. He had Dropsy in the arms and legs when he was a years old; but this soon passed off. A year later he noticed a small lump at the right angle of the Jaw, which spread very rapidly, and in six months had spread all over the jaw and chin to the opposite angle of jaw. The condition next affected soft parts of nose, and both cheeks. He was treated by several medical men without any marked improvement resulting.

(c) Previous Treatment: - He attended at the West Ham Infirmary for several years, where he was scraped, cauterised, and had carbolic acid applied locally. Also attended at the St. John's Hospital for Diseases of the Skin, Leicester Square, where he had the same treatment for some years, taking Kepler's Extract of Malt internally. After
that he again returned to the West Ham Infirmary and was sent to our Hospital from there.

(d) PRESENT TREATMENT: He was scraped on the 30th and had Oxygen applied on the 2nd December. The conjunctival mucosa of the right lower lid was also affected. Patient still under treatment.

(See Illustrations on pages 32 & 33.)
On Admission.
21st November, 1889

Shortly before Discharge.
LUPUS VULGARIS

On Admission

Culture made from scraping from face and examined showing:
(a) Diplococci
(b) Few isolated staphylococci.
(c) Rod Bacteria.
(d) Sarcinae.

Stained Carbol Fuchsin.

Shortly before discharge.

Practically pure Culture Staphylococci Pyogenes Aureus et Albus.

Stained Carbol Fuchsin.

Temperature Chart.
CASE 4. = ROSE SAVILLE. Age 32. Single.

Residing at = Laburnum Cottage, Lower Mitcham, Surrey.

Occupation = Household Duties.

Admitted = November 17th, 1899

Discharged = To be discharged shortly.

HISTORY:

(a) Family History = Mother alive and well. Father died eight years ago from consumption. A sister died in infancy of Whooping cough. Five sisters and one brother alive and well. Her Father's three sisters died of consumption between the ages of 50-60. Thus a marked Tuberculous history on the Father's side. Home surroundings comfortable, plenty of good food and fresh air.

(b) HISTORY OF DISEASE = About thirteen years ago she had a severe attack of Peritonitis, which left her very weak. About a month later she noticed a small red pimple just in middle of upper lip, a few weeks later began to discharge.

(c) PREVIOUS TREATMENT = She saw her Doctor who sent her to Nose and Throat Hospital, Golden Square. Here the pimple was scraped and cauterised and treated by local applications of Iodoform Ointment. The primary Nodule got much better under treatment; but two small spots appeared on the point of nose, right side. These were treated similarly. She next went home and for some time was attended by private Doctors, she also spent several months at Seaside, Brighton and Margate. She then attended Guy's Hospital for some time and eventually went to King's College Hospital, where she was treated with Koch's Anti-
tuberculin treatment by Mr. Watson Cheyne. She was injected in the muscles of the back between shoulder blades at first every three days—she was very ill after first injection, temperature going up to 105° F. then treatment was stopped for a day or two, and injections thereafter repeated daily, with very good results, spots completely disappearing. Six months later condition again started, Patient then tried Sea-bathing and went home for six years, again receiving private treatment.

(d) PRESENT TREATMENT:—The condition getting worse, she was recommended to the Oxygen Home and admitted. Scraped on the 30th November and two days later Oxygen applied. She presented the following appearance on admission. The photo showing the parts involved.

See illustrations on pages 36 & 37.)
On Admission.
17th, November, 1899

Shortly before Discharge.
On Admission

Culture of Scraping taken from Nose and showing:
(a) Torula
(b) Rod Bacteria.
(c) Diplococci.

Lupus Vulgaris

Stained Carbol Fuchsine.

Shortly before Discharge.

Culture taken from small spot on cheek showing:
Staphylococci Pyogenes Aureus et Citreus

Stained Carbol Fuchsine

Temperature Chart.
CASE 5. KATIE CLARKE. Age. 19. Single.

Residing at = 7, Cooper Street, Dublin.

Occupation = Nil.

Admitted = 6th March, 1899

Discharged = 20th April 1900.

HISTORY:

(a) Family History: Father died of Heart Disease after Influenza. Mother alive and well. One brother alive. Patient has comfortable home, good surroundings and plenty of good food. Takes no stimulants.

(b) HISTORY OF DISEASE: Patient has always been healthy and never had any ailment. About ten years ago she noticed a small red spot just under the chin. At first nothing was thought of it; but after a while another spot appeared close to this one, the two amalgamated and the condition gradually became worse.

(c) PREVIOUS TREATMENT: She then became anxious and consulted a Doctor, who treated her with Sulphur Ointment externally and an Iron Tonic internally, she remained under this treatment some months, but it gradually got worse, and then broke out in one spot on the point of the nose. The spot under the chin gradually spreading to each cheek. She next went to Richmond Hospital for some time, where she was scraped and cauterised by Sir Thornley Stoker several times. She improved considerably, went out and attended as an out patient for some time.

Unfortunately the condition again started, she was again
taken into Hospital, and this time inoculated between
the shoulder blades with Koch's Antituberculine. She felt
very ill after the first few inoculations, her temperature
going up, the inoculations were stopped for two days,
thereafter she had them daily for some weeks. This had a
very beneficial effect, the Lupoid areas drying up and
disappearing. She went home, thinking she was completely
cured; but after two months it again started, so she went
back to Richmond, and attended there off and on for eight
years.

(d) PRESENT TREATMENT;— On the 6th of March she came to
the Oxygen Home. When I saw her early in May, the Lupus
had completely removed the soft tissues of nose, involved
both cheeks and spread down the neck. The two months
Oxygen application had completely dried up the unhealthy
tissues around the mouth and chin and upper part of neck.
She was then receiving applications of Oxygen to the
cheeks. She made marked progress and by the end of July
the right cheek healed, and then the left cheek was
treated and left lower eyelid, by end of November this had
greatly improved, and by the end of December was nearly
completely healed except for a small spot on the centre
of the left cheek.

This has been a very chronic case; but the
patient is progressing very satisfactorily and will
shortly be discharged.

(See illustrations on pages 40 & 41.)
After Admission
Culture taken from scraping of face, two months after Admission and examined, showing:
(a) Diplococci.
(b) Rod Bacilli.
(c) Staphylococci.

Stained Carbolic Fuchsin.

On Discharge
Pure Culture --
Staphylococci Pyogenes
Albus et Citreus.

Stained Carbolic Fuchsin.

Temperature Chart.

Residing at = New Brompton, Kent.
Occupation = Household duties.
Admitted = 3rd February 1900
discharged. = 10th April 1900.

HISTORY:-

(a) Family History:- Father died when patient was an infant, she does not know what he died of. Mother died of Heart disease. Two sisters alive and well. Has a comfortable home, good surroundings, plenty of fresh air and good food. She takes beer occasionally to her meals.

(b) HISTORY OF DISEASE:- Patient had measles during childhood but has not had any ailment since, and has been very healthy till the present illness started. She is a married woman and has eight children. These were born in rapid succession, and is a result left her very weak.
About three years ago patient noticed a hard painless nodule about the size of a pea, on the left side of nose, midway between the bridge and the corner of the eye. This caused her some anxiety and she consulted a Doctor.

(c) PREVIOUS TREATMENT:- She consulted a Doctor at St. Bartholomew's Hospital, Rochester, who told her to wait till it was larger, and two months later at Christmas time it was opened. After operation the wound did not heal up and a year later it broke out at the lower part of left side of nose, little hard nodules appearing, same as the original one. She then went to her private Doctor who gave her a Tonic of Arsenic and Iron internally, and
Ointment for external application, she continued this treatment for a year and a half without any improvement. By this time the disease had spread over the point of nose. She next went to the great Portland Street Nose and Ear Hospital, where she attended for some time without deriving much benefit, she then came to the Oxygen Home.

(d) PRESENT TREATMENT:— On admission the disease had involved the soft tissues of nose, the upper lip and both cheeks (vide photo). She was scraped on Thursday, 3rd February, and after that Sterilised water dressings were applied, and on Saturday, the 10th February, she went under Oxygen, as the Mask was not ready before that time.

(See illustrations on pages 44 & 45.)

N.B. In each of the Lupus cases previously described, the Lupoid areas were from time to time scraped, so that each patient has undergone several operations between period of admission and discharge.

The sterilised water dressings were applied over night and the Oxygen Gas on the following day, as described previously.
On Admission.
3rd February 1900

On Discharge.
10th April 1900
On Admission

Culture made from scraping taken from upper lip—:
showing—:
(a) Diplococci.
(b) Colonies of Staphylococci.
(c) Rod Bacilli.

Stained Carbol Fuchsin.

Shortly before Discharge

Staphylococci Pyogenes Citreus.

Stained Carbol Fuchsin.

Temperature Chart.

Mrs. Burrige  Age  33. Disease  Lupus of Face  Result Satisfactory

February 1920

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(Updated clinical chart)
TREATMENT OF PNEUMONIA BY OXYGEN INHALATION.

Oxygen Gas has during the last few years come to play such an important and extensive part in the treatment of Pneumonia, that it is at the present time considered to be one of the chief Therapeutic applications in this common and oftentimes fatal disease.

It has, up to very recently, been used only in that stage of the disease, where there is marked difficulty of breathing and cyanosis, and it acts most beneficially by relieving the Dyspnoea.

It has been my experience that the earlier in the course of the disease Oxygen is administered, the better the prognosis is for ultimate cure of the patient. It certainly does no harm, on the contrary, it acts most beneficially by reducing high temperature, and greatly eases embarrassed respirations.

At the Hospital the routine of treatment adopted in cases of Pneumonia is the giving of Oxygen at the very beginning of the disease, just immediately after the initial rigor and rise of the temperature. Poultices are of course applied, and drugs given when indicated for cough or cardiac weakness. The Gas is given to the patients by means of a tube attached to a Gas bag and ending in a soft bulb which is inserted into the nostril. It is, I think, advisable that the Oxygen should not be used direct from the cylinder but should be decanted into a Gas bag before being inhaled.
because - (1) The Oxygen in the cylinders and issuing from them is at far too low a temperature to be used with safety for inhalation.

(2) By the use of a bag, containing a certain amount of the Gas, you can accurately estimate the amount used per hour, and better regulate the pressure under which the Gas is inhaled.

In the twelve cases, which have come under my notice, very excellent results were obtained by the early administration of the Gas. The effect on the temperature was very marked indeed, as will be seen by referring to the appended Temperature Charts.

The following six cases I am recording were taken at random, and not specially selected.

CASE 1. MISS F. Age 23. Single.
Residing at - 3, Belgrave Square, Monkstown, Dublin County.
Occupation - Hospital Nurse.
Admitted - May 2nd, 1899
Discharged - May 24th 1899

Complaint - Patient complained of a feeling of chilliness, with pain in the back and left side. Headache and vomiting.

HISTORY.

(a) Family History: Father died of congestion of the Lungs. Mother alive and well. One brother died of Scarlatina. One sister of consumption. Four sisters alive and well.
(b) GENERAL HISTORY:—Patient previous to the time she was taken ill, had a most comfortable home with good surroundings, plenty of fresh air and good food. She takes no stimulants.

(c) PREVIOUS ILLNESSES:—As a child patient had measles and scarlet fever, and had congestion of the lungs when about eighteen years of age.

(d) PRESENT ILLNESS:—About the end of April patient caught a very severe chill, in crossing over from Ireland. She felt very poorly for two or three days, and on May 2nd she developed pneumonia in the left lung. On the above date she got up as usual to attend to her duties, but was shortly afterwards obliged to return to bed. She had a very severe headache, her face was flushed and cough troublesome. She complained of pain above the left breast running backwards below the left shoulder blade. At 10 a.m. in the morning the temperature was 103°F, the pulse 95 and the respirations 30. In the afternoon she began to bring up glutinous expectoration, with the characteristic “prune juice” colour.

(e) PHYSICAL SIGNS:—On inspection marked impairment of movement on the left side. Bullness on percussion over the left base. On auscultation the vocal resonance was found to be markedly increased, tubular breathing elicited and fine crepitations heard all over the base and back of the left lung.
(f) TREATMENT: - In the early morning ten grains of Phenacetine were given to relieve the headache. At 4 p.m. the inhalation of Oxygen was begun and linseed poultices were applied to the side and back of the left chest. At 10 p.m. the temperature had fallen to 101°. On May 3rd. (the second day) at 2 a.m. the temperature was again 101.8° at 6 p.m. it was 99°. There was very little cough and no pain and the expectoration which had much diminished, was only slightly discoloured. At 6 p.m. the temperature was 102.2° the pulse 92 and the respirations 20. She passed a quiet night and at 10 p.m. the temperature fell to 100°. On the 6th. at 2 a.m. the temperature was normal: at 6 a.m. and also at 10 a.m. it was 98.2°. The pulse was 72 and the respirations were 20. There was very little expectoration and it was untinged. The poultices were discontinued. Up to this the Oxygen inhalation was continuous, the amount used being one cubic foot in two hours. On the 7th the patient slept well all night. There was no cough, pain or expectoration. On this day only two or three cubic feet of oxygen were inhaled at intervals. The temperature was 97.4° at 2 a.m. and 97.6° at 6 p.m. On the 8th the patients' temperature was 97.4° at 2 a.m. and 97.3° at 6 p.m. As she was feeling well, she was allowed up for a couple of hours. She must have got a chill, for on the next day, May 9th, she had a severe rigor at 7 a.m. At 10 a.m. her temperature had risen to 103° and the cough and rusty expectoration - in fact all the original symptoms - reappeared. In the early morning she had 10 grains of phenacetine to relieve the headache.
The poultices were renewed and oxygen inhalation resorted to. At 10 p.m. the temperature was 103°.

On the 10th at 6 a.m. the temperature was 100°. The pulse 92 and the respirations 32.

On the 11th the temperature went up to 103°, pulse 100, respirations 28.

On the 12th, 6 a.m. temperature had fallen to 101° and in the evening at 7 p.m. it had reached the normal.

On the 13th, 14th, and 15th, there was no change in the condition of the patient. The temperature fluctuating between 97.2° and 97.8°. There was no pain, cough, dyspnoea, or expectoration. The Oxygen was discontinued.

On the 16th, 17 and 18th, patient continued to improve, and was up for a short time during each of those days. She took her ordinary diet and slept well at night. On the 24th she left for the "Nurse's Convalescent Home" at Brighton, where she spent three weeks. She returned looking very well and having regained her usual good health and being once again able to resume her ordinary duties.

(g) SPUTUM:— A coverglass preparation of the expectoration was made which showed the Diplococci Pneumoniae, and tubes inoculated from the sputum showed the same micro-organisms, also epithelial cells, and Debris composed of epithelial cells undergoing degeneration and blood corpuscles.

(See page 51.)
On Admission.

Slide prepared from Sputum and examined microscopically by 1/12 oil immersion lens, showing following:-

(a) Diplococci Pneumoniae.
(b) Epithelial cells with nuclei.
(c) Pus cells.

Stained by Carbol Fuchsin.

TEMPERATURE CHART.

Residing at - 112, Regent Street, London. W.

Occupation - Nil.

Admitted - December 23rd 1899

Discharged - January 5th. 1900.

Complaint. - Very bad headache, Pain on left side just below heart, at the back pain felt at the lower end of the left shoulder blade. Feeling very hot and uncomfortable, with a parched mouth and intense thirst.

HISTORY.

(a) Family History. Father died of Heart disease, following on several very acute attacks of Rheumatic fever. Mother alive and very delicate, suffering at times from acute exacerbations of gout. One brother drowned at Sea. One sister died of Heart disease after being a sufferer from Bronchitis for years. Two died in infancy cause not known. Five brothers and three sisters alive and well.

(b) GENERAL HISTORY: Patient always had a very comfortable home with good surroundings. Always the best of meals, but patient has never a very good appetite. She usually takes wine or beer to her meals. Never takes stimulants to excess. Has been in the habit of smoking cigarettes since her last attack of Asthma. She smokes about 12 to 15 a day.
(c) PREVIOUS ILLNESSES:— She has been subject to several attacks of Rheumatic fever, which she had at the ages of 13; 17; and 22, respectively. She had Diphtheria when 9 years old. Had Quinsy about two years ago, and previous to that time she had had several attacks, the first attack shortly after she had diphtheria. She had congestion of the Lungs at 24.

After her confinement of twins about 5 years ago, she had puerperal fever and Cellulitis. Patient informs me that she had contracted Syphilis from her husband about three years ago, and had abscesses all over her body. She has during the last two years, suffered intensely from distressing attacks of Bronchitic asthma.

(d) PRESENT ILLNESS:— Patient had a very severe attack of Influenza about the beginning of December, she was laid up for about ten days, and a week later, about the 19th December, after having been out in the wet, she came home feeling very poorly, and shortly after this, developed a rigor, accompanied, or rather followed, by headache and pain in the back and left side. She took to her bed, and not improving, came to the Hospital on the 23rd December, on the 4th day of her Pneumonia. On admission she had a very severe neuralgic headache affecting the nerves of face as well, also intense pain in the left side, especially at the inferior angle of the left scapula. She had a hard painful cough, and viscid rusty expectoration.

(e) PHYSICAL SIGNS:— Inspection showed loss of movement on the left side, with very limited expansion. Palpation
gave increase of vocal resonance over the left side, especially marked at base and over upper lobe. Percussion—Dullness at left base and over upper lobe, marked at inferior angle of scapular and vertebral border, auscultation revealed fine crepitations over upper lobe accompanying the Tubular breathing which was elicited over the same area.

(f) TREATMENT: - On admission a large sinapism was applied to the whole area of the left lung; both in front and behind, after that the whole chest was carefully wrapped up in cotton wool. Continuous administration of Oxygen was next resorted to. This was given through a nasal tube, and continued until the “Crepitus Redux” appeared, when counter irritation was applied in the form of Iodine. The very marked effect will be readily seen by referring to the accompanying Temperature Chart.

After some days, when the Temperature had fallen, the patient complained of a very severe neuralgic headache, and the Phenacetin was given in 5 grain doses every three hours. This was soon relieved by treatment and the patient made an excellent recovery. During convalescence she was put on a tonic containing Arsenic and Strychnine.

(g) SPUTUM: - The typical prune juice, rusty, viscid, Pneumonic Expectoration. A culture and coverglass preparation was made of the Sputum, showing numerous colonies of Diplococci Pneumoniae, also Epithelial cells, pus cells and elastic fibres, etc.

(See Page 55.)
On Admission.

Sputum examined by 1/12 oil immersion lens showing:

(a) Diplococci Pneumococci,
(b) Epithelial cells with Nuclei.
(c) Pus cells.
(d) Elastic fibres.

Stained by Carbol Fuchsin

TEMPERATURE CHART.
Residing at- Ormond Quay, Dublin.
Occupation - Hospital Nurse.
Admitted - December 28th. 1899
Discharged - January 16th. 1900

Complaint - Patient complains of pain on the right side, intense headache, and a feeling of nausea, loss of appetite.

HISTORY:-
(a) Family History: - Father died of Bright’s disease, Mother alive and well, one brother and three sisters died in infancy, cause unknown. Two brothers and four sisters alive and well.

(b) General History: - Always had a comfortable home with good and healthy surroundings, plenty of food and good appetite, takes plenty of tea, but no alcoholic Stimulants.

(c) Previous Illnesses: - Patient had a very bad attack of Measles as a child, and also a very severe attack of whooping cough, which left her very weak.

(d) Present Illness: - The week preceding the 28th December, when patient took ill, was a very cold and wet one. Patient had occasion to go out a great deal, and was exposed to the inclemency of the weather. On the 26th, the patient, on coming home complained of a very irritating cough; but went out the next day again. On the evening of the 27th, on returning home, the patient felt very poorly with headache, pain on the right side, front and back, and
a nasty irritating cough, which greatly aggravated the pain. The temperature was 103° F. and continued high the next day, going up to 103.5° F. with headache, loss of appetite, thirst, and a hot dry skin.

(e) PHYSICAL SIGNS:— Inspection revealed limited expansion over right side, Palpation gave increased vocal Fremitus over right side, especially marked over right base behind. Percussion gave absolute dullness over right base with a feeling of resistance to the percussing finger. Auscultation revealed harsh tubular breathing accompanied by fine crepitations on Inspiration, heard very well over both front and back of right side, marked vocal Resonance at right base.

(f) TREATMENT
Poultices were applied both in front and behind, (jacket poultices) of Linseed Meal, these were applied at intervals, every four hours for the first 48 hours. Oxygen Inhalations were commenced on the morning of the 29th, on the evening of the 29th the temperature was 103.5° F. it fell during the night, and the morning of the 30th it had fallen to 102° F.; by the evening it had fallen to 101° F. The patient slept badly that night, and the next day temperature again rose, on the evening of the 1st. January, the temperature was 103° F. Next morning fell to 101° F. During the day it fell rapidly and by night it was down to 99° F. During the next few days the patient felt ever so much brighter, and the temperature oscillated between 99° and 100° F.; after that it went to
normal, where it remained, the cough and physical signs disappearing entirely. She made an excellent recovery. During convalescence she was treated by counter irritation to the chest. She left the Hospital on the 18th, for a holiday in Ireland.

(g) SPUTUM:— Showed numerous Epithelial cells, with groups of Diplococci Pneumonii, also pus cells.

(See page 59)
On Admission.

Slide prepared from Sputum and examined microscopically by 1/12 oil immersion lens, showing the following:
(a) Diplococci Pneumoniae.
(b) Epithelial cells with darkly stained nuclei.
(c) Pus cells with horse-shoe shaped nuclei,
(d) Spirilla.

Stained by Carbol Fuchsin.
CASE 4. Mr. A. P. Age 27. Single.

Residing at = 3, Lancaster Gate.
Occupation = Nil.
Admitted = October 20th, 1889
Discharged = November 8th, 1889

Complaint:— Pain over the right side. Short hacking cough.
Thirst and cold shivers three days previously.

History:

(a) Family History:— Father and Mother alive and well. Two
brothers and a sister alive and well. One brother died in
infancy, cause not known.

(b) General History:— Patient has a very comfortable home,
and excellent surroundings. Plenty of fresh air. Has been
in the habit of taking wine to his meals.

(c) Previous illnesses:— Patient has always been well and
strong. About seven years ago he had an acute attack of
Rheumatic Arthritis, from which he perfectly recovered. This
followed as a result of Gonorrhoea which he had contracted.

(d) Present Illness:— On the 16th of October the patient
was out cycling; he was caught in the rain. Went to Rail-
way station and had to wait half an hour on the platform.
Went home and the next day complained of shivering and
headache.

(e) Physical Signs:— On inspection showed a furred tongue
and revealed marked impairment of movement over the right
side. Percussion gave dullness over the base and upper lobe.
Palpation revealed a hot dry skin and an increase of vocal Fremitus over the right side. On auscultation fine crepitations were elicited over upper lobe of right side back and front.

(f) Treatment:— Oxygen was given from the very beginning. It greatly relieved the Respiratory embarrassment and the cough. The temperature was 104.4°. The Oxygen Inhalations were supplemented by Linseed Poultries both behind and in front. The Urine was examined and showed a marked deficiency of Chlorides. The temperature fell almost a degree during the first few hours. After twenty-four hours administration further fall of 1 1/2° with slight rises at night. The temperature continued to fall until the tenth day of disease, when it reached the normal. The respirations became normal—the skin moist, and Chlorides present in the Urine. On Auscultation the "Crepitus Redux" was elicited, and resolved in two or three days. At the beginning there was the usual viscid rusty Expectoration, this finally becoming more copious and more readily expectorated.

(g) Sputum:— Examined microscopically showing numerous Diplococci Pneumoniae. Pus cells and Epithelial cells.

(see illustrations on page 62.)
On Admission

(a) Epithelial Cells
   with nuclei darkly stained.
(b) Pus cells.
(c) Diplococci Pneumoniae
(d) Elastic fibres.

Temperature Chart.
CASE 5.  Mrs. H--- Age 45. Married.

Residing at = Bloomsbury Square.
Occupation = Domestic duties.
Admitted = September 1st. 1899
Discharged = September 17th 1899


History:

(a) Family History: Good. Father and Mother both died at a good old age from general debility. Three sisters alive and well. One brother died abroad of fever.

(b) General History: Patient has a comfortable home and good surroundings. Good food. Stimulants in moderation.

(c) Previous Illnesses: Patient had measles and chicken pox as a child. Latterly patient had several attacks of Influenza. Patient subject of gouty diathesis—every now and again having acute gouty exacerbations.

(d) Present Illness: Caught cold at a Bazaar by standing in a draught. When she got home she felt very cold and shivered several times. The next day she felt very ill with a dull heavy pain in the head and running from nose.

(e) Physical Signs: On inspection of chest diminished expansion was noted on both sides. Palpation vocal Fremitus diminished. Heart Apex beat depressed down and out. Percussion—Cardiac Superficial dullness apparently
diminished. Deficient resonance over back and front of both lungs. On Auscultation slight tubular breathing was elicited over same area. No vocal resonance and no Crepitations were elicited. Next day there was slight Expectoration which on examination revealed Diplococci Pneumoniae, this became more viscid and rusty a few days later and finally it became more fluid and more easily expectorated.

(f) Treatment: In this case too, Oxygen was given from the very start of the disease. During the first few nights the patient was very nervous and restless, and slept very badly. The patient took the oxygen very badly complaining of headache—the cause of this was probably due to the Chlorine in the Gas. This was got rid of by previously passing the Gas through Permanganate of Potassium solution the headache then completely disappeared. The temperature during the first few days oscillated between 103° and 104°F. After this it gradually fell and reached the normal on the sixth day of the disease, in the morning, with a slight evening rise—this continued during resolution stage which was complete fourteen days after the onset. The Oxygen acted very beneficially in reducing the temperature, and relieving the cyanosis and precordial distress. After the sixth day she took freely of nourishment which was supplemented by small doses of Scotch Whisky. She made an excellent recovery. In this case, too, the Oxygen Inhalations were supplemented by Jacket poultices of Linseed meal.
(g) Sputum — Numerous Diplococci Pneumoniae— Epithelial cells, Pus cells and cells debris composed of blood cells and degenerated Epithelial cells.

On Admission.

(a) Diplococci Pneumoniae.
(b) Epithelial cells
(c) Pus cells.
(d) Cell Debris + Blood cells.

Temperature Chart.
CASE C.  Mr. C. W.  Age 28.  Single.

Residing at Albermarle Street

Occupation = Naval Service.

Admitted = September 15th 1898

Discharged = October 5th 1898.

Complaint = Pain on left side, increased by deep breathing.

Headache, sickness and loss of appetite.

History:

(a) Family History: Father alive and suffering from 

Asthma. Mother died of Consumption at the age of thirty-

seven. Lost two brothers with chest complaints, probably 

Phthisis.

(b) General History: Comfortable home and surroundings. 

Patient smokes heavily and occasionally takes stimulants.

(c) Previous Illnesses: Patient had measles as a child. 

About four years ago he contracted Malaria on the West 

Coast of Africa.

(d) Present Illness: While spending a short holiday at 

home, he got cold—this getting worse he put it down to 

Influenza. One day he could not get warm and shivered 

repeatedly. He then thought that this might be due to the 

remains of his Malarial fever. Next day he felt very ill 

and the pain in his left side developed.

(e) Physical Signs: On inspection revealed want of 

expansion and movement on left side, especially left apex. 

Palpation showed hot dry skin, and impaired vocal Fremitus. 

On Percussion dullness and deficient resonance were
elicited at left apex, with badly marked deficiency of
Resonance over the lower Lobe back and front.
Auscultation revealed marked increase of Vocal Resonance
over left Apex, also fine crepitations confined to an area
of two to three inches. Next day crepitations were marked
over a wider area. It slowly engaged the whole of left side
in small patches. One part appeared to recover itself,
another was attacked.

(f) Treatment: The temperature in this case went as high
as 105°F. Oxygen was administered from the commencement. At
the end of twelve hours the temperature had fallen to
103.8° in the morning, with another rise in the evening. It
then oscillated between 103° and 104°, and on the sixth day
fell to 101°. After this there was a daily drop of half a
degree till it reached the normal on the eighth day from
onset. Counter irritation by application of Iodine was
resorted to, during stage of Resolution.

The Oxygen treatment was supplemented by Linseed
Foultries.

This was probably a case of Creeping, Patchy
Pneumonia following Influenza- this accounting for the
maintenance of high fever.

(g) Sputum: Rusty viscid at first. More copious during
resolution, and more readily expectorated. On microscopic
examination revealed Diplococci Pneumonici in great numbers
and Epithelial cells.

(See illustrations on page 68)
On Admission.

(a) Pus cells with horseshoe shaped nuclei.
(b) Diplococci Pneumoniae.
(c) Epithelial Cells.

Temperature chart.
THE OXYGEN TREATMENT OF ULCERS.

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HISTORICAL RETROSPECT OF THE TREATMENT OF ULCERS:

I do not intend entering into any elaborate details but wish briefly to summarise the treatment of ulcers from the earliest time to the present day treatment.

The treatment of wounds, ulcers and other abrasions of the skin surface have occupied the minds of men from the very earliest of times.

Hippocrates, Galen, Celsus, Fallopius, and many of the older writers make mention in their works of various forms of ulceration and their treatment.

The surgeons in the 17th Century held the theory that all diseases, including ulcers, were caused by the presence of certain humours in the body, and that by getting rid of these they hoped to cure the local condition of ulceration. In order to do this efficiently, they gave their patients either very drastic internal remedies; or resorted to extreme blood letting, measures which certainly did not effect the cure it was intended; but on the contrary made them considerably worse.

Later on, certain applications began to be used, such as oily infusions, Animal fats, Emollient Cataplasms and dusting powders such as Barley flour; and resinous substances, such as pitch and tar.

Still later agents began to be applied with a view to stimulating the process of healing in the ulcer, such as Blue stone (Copper Sulphate) and Lunar Caustic
(Silver Nitrate) Lead Lotion etc.

Then the Germ theory of Disease came into vogue; by which it was demonstrated that certain micro-organisms were responsible for the inflammatory condition and attendant pus formation met with in the process of ulceration; various theories were then propounded as to where these organisms came from, some maintained that they originally existed in the blood, and made their presence felt, when from any cause the vitality or tonicity of the tissues locally was lost; or the vitality of the individual as a whole was below par, as for example, after certain debilitating diseases.

Others maintained that these organisms were present in the Lymphatics primarily, and got into the blood stream indirectly. Another party favoured the view that these minute organisms got into the system through the pores of the skin and sebaceous ducts, directly.

Whatever view might be favoured, the fact remained, that all forms of inflammation and ulceration, were associated with the presence of these micro-organisms. The next step was to find the means of getting rid of these microscopic intruders. It was found that a great many of the acute inflammatory and ulcerative conditions improved very markedly by keeping the inflamed surfaces clean and resting the part and toning up the tissues by giving tonics internally.

Then certain Antiseptic agents came to be locally applied
in varying strengths such as Boracic Lotion; Carbolic Lotion; Corrosive Sublimate; and dusting powders such as Iodoform Powder and Boracic Powder, Ointment such as Iodoform, Boracic, Mercuric etc. Good results have also been obtained by massage, and by Skin grafting in extensive ulcerations. These various remedies have certainly proved themselves very effective in most cases; but, unfortunately in some cases of Chronic Ulcers, they have done little material good, in fact, have more often done just the reverse. This may be due to the too great anxiety on the part of the medical attendant to cure the condition too quickly, and applying these agents in too strong solutions, which are undoubtedly detrimental to the process of healing.

Mr. John Hunter, in his Treatise on the Blood, says, "In reference to Lead Lotions, I am certain I have seen Lead increase such inflammations, particularly in many inflammations of the eyes and eyelids, and I believe it is a bad application in all scrofulous cases and processes of ulceration" (Treatise on Blood, Page 350)

Dr. Benjamin Bell states that he has derived great benefit by applying pressure in cases of not very acutely inflamed ulcers, he does this by applying stockings and bandages, which support the part and prevent oedema. He further goes on to say that "whatever tends to keep up any considerable inflammation in sores, has a certain effect in putting a total stop to the production of granulations. Hence the necessity of removing from the wounds and ulcers every extraneous body, or whatever tends to produce
irritation, and from the same circumstances, is accounted for the great advantage of dressing seldom, with mild simple applications instead of the practice which formerly prevailed (and often still prevails) of dressing much more frequently, and that too, with very complex irritating ointments and washes. The careful removal of all irritating pus by keeping the surface of ulcer clean, and promoting the formation of laudable pus. (Treatise on the Theory and Treatment of Ulcers. p.p. 155-159-164)

Mr. Watson Cheyne says: - That in order to treat cases of ulceration properly, you should remove the various causes of irritation which he classes as:

(a) Mechanical = Bandages and Dressings.
(b) Chemical = Chiefly in form of Sepsis.
(c) Presence of decomposing discharge on the surface.
(Treatment of wounds, ulcers, abscesses, p. 119)

I could quote several more authorities to show the baneful results arising from the application of dressings or too strong antiseptics to ulcerated or wounded surfaces; but it would only take up unnecessary space and time.

Now various methods have been applied within recent years to obviate the direct application of antiseptic dressings and agents to the affected parts. These are as follows:

(A) FINSÉN’S PHOTOTHERAPY

Finsén found that certain Chemical Rays (Blue, violet, Ultra-violet) caused an inflammation (Erythema Solare) of the healthy skin and he assumed that they would
be capable of aggravating pre-existing inflammation. If therefore the skin were to be protected against the injurious action of the Chemical Rays of light, it will be possible to diminish the intensity of the inflammation. The object is therefore to exclude the rays of light which are injurious to the skin. This new mode of treatment is now used by Finsen with great success in the curing of superficial Bacterial Skin Diseases. Full particulars will be found by referring to British Medical Journal, September 30th 1899. p.p. 825- 830- and 1373.

(B) NEW METHOD OF APPLYING ANTISEPTIC

DRESSINGS.

Dr. Archibald Reid, in his article on the Treatment of burns and other surface wounds says:—

"The surgical dressings are not placed on the wound, but on a light wire cage or support, which thus while permitting them to afford protection, prevents them from acting as foreign bodies. The apparatus when properly adjusted, may be covered by any dressings the surgeon may choose, and it is retained in its place by strapping or bandages.

The surface of the wound is sponged thrice daily with some mild antiseptic fluid, such as Boracic Acid or weak (1-40) Carbolic Lotion, otherwise the discharges from the wound coagulating form a cake under which pus is retained, which acts as a foreign body to the wound. The advantages claimed for the above method are briefly
(1) Using foreign bodies (i.e. dressings and antiseptics) not as applications directly to the wound; but retaining them for the purpose of protection.
(2) The wound is quickly, easily and painlessly dressed.
(3) It prevents superabundant granulations forming; and it gives rise to a smooth cicatrix, and not to the thick cicatrices, which are often puckered owing to the contraction of the excessive fibrous tissue formation, in wounds or ulcers treated by direct antiseptic dressings.

*(British Medical Journal, Oct. 28th, 1899. p.p. 1187-1188. 1)*

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**HOLLÄNDER'S HOT AIR TREATMENT.**

This method of treatment was first suggested to Holländer by Professor Sheguirew, who successfully utilised steam, at his Gynecological Clinique at Moscow. Holländer first tried steam applications to the diseased parts, but did not meet with very marked success. An idea then struck him that heated air might be more efficacious, and in order to apply this, he devised a very ingenious apparatus; a coiled tube in connection with a cylinder containing air under pressure, the air passing through the coiled tube, which was kept at a red glow by a Bunsen burner. The air was heated to a temperature of about 300° C. The heated air can be concentrated on the diseased tissues, like the Paquelin Cautery, without damaging the surrounding healthy tissues. He applied the air to the parts under an anaesthetic, and states that the patients do not
feel any painful after effects—this he thinks is due to the fact that the nerve endings of the Sensory Cutaneous nerves had been destroyed by the heated Air. The parts subjected to the hot air become very white and bleached; but after a few days, when the circulation is re-established, assumes its normal colour again, the parts soon healed again, the unhealthy tissues sloughing off and a new skin growing over the parts from the centre of a mass of granulation tissue. After the hot air is applied, a Boracic Lanoline ointment is applied to the parts on a dressing.

Holländer had some splendid results with this mode of treatment, especially in cases of Lupus. He describes some very good cures of the latter, especially one case of a boy who had the disease of upwards of fifteen years, and presented a leprous appearance, so much so, that he was debarred from all society and became a burden to himself. This is really a splendid result and compares very favourably with one of our most chronic Lupus cases. Catherine Clarke, which I have alluded to on page (88)

Holländer also reports another interesting use to which he has put this Hot Air. After a very extensive operation for total extirpation of the Gall Bladder and the Cystic Duct for Carcinoma, there was extensive haemorrhage, and this was successfully checked by the application of heated Air. Fuller details will be found by referring to his articles.


"Total Extirpation der Gallenblase und des Ductus Cysticus nebst guerner Leberresektion wegen Carcinoma"

"Blutstillung mit Luftcauterisation Deutsche Medicinische Wochen Schrift. (Vol. xxiv. p. 413)"
Now we come to the treatment of Wounds and Ulcers by Oxygen Gas. As I have during the past year used this and seen it used with very great success in cases of chronic ulcers that have withstood all other forms of treatment, I think I am justified in claiming for Oxygen Gas a place among the numerous Therapeutic agents that have been brought forward in the treatment of Ulcers and abrasions of the Skin.

The effect of Oxygen on Micro-organisms has already been referred to in an earlier part of the paper. In a series of experiments I made along with Dr. Stoker we got some very interesting results. We took a scraping from a very chronic ulcer on the leg of one of our female patients who had come into the Hospital, and made a culture on agar-agar jelly, inoculated this at body heat (37° C, or 98.6° F) in an incubator, having a self regulating gas jet, and after 48 hours, prepared a slide, stained and examined microscopically. We found a great number of Rod Bacteria micrococci and Diplococci. We then transferred the rest of the culture to a glass flask exhausted of air, removed the cotton wool stopper covering the opening of tube and filled the flask with oxygen, thus allowing it to play directly on the culture. After a few days we examined it again and found that the staphylococci had increased in amount and size, and that the Diplococci and Rod Bacteria had grown much smaller

(See illustrations, Page 77)
(A) Flask containing Vacuum.

(B) Tube containing Organisms.

(C) Bag of Oxygen.

(D) Tube conveying the Gas.

On admission
Various Rod Bacteria
Diplococci etc.

After six days growth:
in Oxygen, Nearly cure
Culture of Staphylococci.
By referring to above diagrams it will be readily seen how the proceeding was carried out. We repeated the experiment in several other cases and obtained similar results.

In conclusion, I shall briefly state the effects I have observed by the application of Oxygen to the ulcerated surface, and give a short account of the routine treatment adopted in the Hospital.

(a) The Effect on the Ulcer:

(1) It acts very beneficially in alleviating the unpleasant sensations of pain, burning, throbbing, and heat in the part.

(2) It dissipates the heavy unpleasant sickly odour of the Ulcer.

(3) It acts as a powerful stimulating agent; without causing irritation of the tissues.

It thus practically embodies all the most important uses of any of the antiseptic agents, with the additional benefit, that it is non-irritant.

(b) Routine Treatment in Hospital: The patients on admission have the parts thoroughly cleaned. The Ulcer and surrounding tissues are thoroughly washed with soft soap and water—next a sterilised water dressing is applied to the part. The Oxygen is then applied to the part, the limb being enclosed in a box, and the gas allowed to play on the Ulcer. See diagram on page 18. The Gas is applied in varying strengths, 1 in 3 of
sterilised air being usually employed, that is 1/3 of Oxygen, or 12%, or sometimes 1 in 4, i.e. 1/4 or 25%. This is gradually raised to 1/2, or 50%.

The patients have the gas applied at 9 o'clock every morning, after having had a sterilised water dressing on all night. At 6.30 in the evening the Oxygen is removed and water dressings again applied. The Oxygen forms a fine parchment like film round the margins of the ulcer over the newly growing skin, and this is from time to time removed by forceps so as to allow the oxygen to reach the underlying tissues.

Sometimes the skin around the ulcer gets very dry, and then lanoline is rubbed in to prevent the skin cracking. The patients are not confined in the recumbent positions all day; but are allowed up for two hours in the morning and three hours in the evening.

I have selected six cases at random, out of the forty treated during the year, and I trust I will be able sufficiently to demonstrate the beneficial results obtained. The following cases are very briefly described and just give the salient points bearing on the case.
CASE 1.

WBS SHEPPARD.  Age 38.  Married.

Residence  Chatham.

Admitted  May 4th, 1899

Discharged  June 10th 1899.

(a) Family History—Good Father and Mother alive and well. Three brothers alive and well. Patient has a comfortable home, good surroundings and plenty of good food.

(b) History and Description of Ulcer: The patient has been very much troubled during the last four years with varicose veins along the inner side of the right leg. About two years ago an Ulcer developed on the inner side of the right ankle, as a result of the bursting of a varicose vein. The condition being very much aggravated by the friction of the stocking.

She had a Doctor attending her at her house, and the condition improved temporarily under the application of fomentations, Lotions, Ointments, etc. But every now and again it started afresh and gave the patient a great deal of discomfort. The condition not improving, she came up to the Hospital, and was admitted on the 4th May. The Ulcer was situated over the Internal Malleolus, and occupied an area of about two square inches. It was very foul smelling, and exquisitely tender and painful, so much so that it kept her awake at nights. On admission the parts about the Ulcer were thoroughly cleansed with a brush and soft soap, and the ulcerated surface washed and tags of skin
and unhealthy granulations removed.

A sterilised water dressing was then applied, and kept on all night, next day the oxygen was applied. On the following day the pain had considerably subsided; but the discharge had become more profuse, but not so foul smelling as it was on admission. From the rapid healing following this it was evident that the increased discharge at first was really a blessing in disguise, as it probably acted by removing the unfavorable micro-organisms, that had found a resting place in the deeper parts of the Ulcer. The condition improved rapidly and every day favorable changes could be noted in the part. She was discharged completely cured on June 10th and has not had any recurrence since. Cultures were taken shortly after admission and again shortly before leaving, i.e. before the Ulcer had completely healed, and revealed the following;-

On Admission.
4th May, 1899.

On Discharge.
10th June 1899.
Case 2.

George Santry. = Age 40.
Residence = Islington, London. N.
Admission = May 15th 1899
Discharged = July 1st 1899

(a) Family History= Good. Father died about seven years ago of some Chest trouble. Mother alive and well. Patient has a comfortable home but his surroundings are poor. Has plenty of good nourishing food.

(b) History and description of Ulcer=: The patient is a cab driver and states that he is very hard worked often not getting home to his bed till late at night. He has been subject to frequent attacks of Eczema on the face.

About six months ago he noticed a small pimple about the size of a split pea at the lower part of the right shin. This used to itch badly at times, and to alleviate it, he rubbed his hand over the part of the trousers immediately over the pimple. It got larger and more painful, and eventually broke, giving rise to an Ulcer. He was treated at various Dispensaries by the applications of Ointment, Lotions, Antiseptic Dressings etc., without deriving any marked benefit.

On admission to the Hospital on the 15th May, the floor of the Ulcer was covered with pale unhealthy granulations, and bathed in foetid pus. The tissue round about Ulcer being very oedematous.

The Ulcer was very extensive occupying lower 1/3 of front
of right leg, and extending all around the external Malleolus. The usual preliminaries previous to the application of the Gas were employed. Oxygen applied on the 16th May. The patient made very favourable progress, and was discharged on the 1st July completely cured.

On Admission
15th May, 1899

On Discharge.
1st June, 1899
CASE 3.  
MRS. EDWARDS.  
Age 30.

Residence = Colchester.
Admitted = June 30th 1899
Discharged = November 4th 1899

(a) Family History = Good. Personal history of contracted Syphilis from her husband who is a sailor.

(b) History and description of Ulcers = About two years ago the patient noticed a small ulcer on the outer side of the right ankle, which appeared after a fall she had. This gradually became bigger and extended in various directions going on to the front of lower end of leg. Six months later a similar ulcer appeared on the outer side of the left leg, commencing just a little above the external Malleolus, and gradually involving the whole of the outer and lower one third of left leg. She was attended at home by a Doctor, who gave her some medicine internally and applied various lotions and Ointments locally, she was laid up for upwards of a year. On the 30th June she came to us- the Ulcers on admission were pretty extensive as will be seen by referring to the photos on admission. In parts they resembled Syphilitic ulcers, in being very punched out looking, but the general appearance of the ulcers was not that of a typical Syphilitic ulcer.
She had Oxygen applied on July 1st., and at first very slight almost imperceptible improvement was noted; but after a month of the treatment, the improvement was very
marked. She had the Oxygen applied in various strengths and was discharged cured on the 4th November.

Showing outer side of right Leg.

On Admission, 30th June 1899

On Discharge, 4th November 1899

Showing outer side of left Leg.

On Admission, 30th June 1899

On Discharge, 4th November 1899
CASE 4.  JANE GOULD.  Age 65.  Single.
Residence. = 6, Foster Cottage, South Hazelmere.
Admitted = July 15th 1899
Discharged = September 9th 1899

(a) FAMILY HISTORY: — Good. Father and Mother both died
at a good old age from general weakness. Patient has a
comfortable home and lives simply but well.

(b) HISTORY AND DESCRIPTION OF ULCER: — Six months ago the
patient noticed a hard painful swelling at the lower and
outer side of left leg. This was extremely painful. One
day while patient was engaged with her household duties it
burst, and the pain was for the time greatly relieved.
She tried several household remedies, and poulticed it
with linseed, without receiving much benefit. She then
called in a Doctor, who ordered her to bed. She laid up
for six weeks and was treated by various Lotions and
Dressings, and also Massage around the Ulcer.
The condition improved somewhat, but as soon as patient got
up again, it started afresh and became as bad as it was
before. She was recommended to the Hospital by a friend,
and was admitted on the 15th July. — On admission the
floor of ulcer was bathed in foetid foul smelling pus, the
edges hard and everted and the surrounding tissues oedematous.
The parts were thoroughly scrubbed with soap and water, the
edges pared down, and sterilized water dressings applied
for two days.
On the 17th July she had Oxygen applied. The condition improved gradually, and by the end of August was nearly healed, excepting for a small area at upper end of ulcer. We then applied some Staphylococci Pyogenes albus from a culture taken from the healing ulcer to this surface, and increased the strength of Oxygen. By the 9th of September she was quite cured and left the Hospital.

On Admission
15th July. 1899.

On Discharge.
9th September. 1899
CASE 5. SARAH BAYNES. Age 50. Single.

Residence = Wilthorpe, Westmoreland.

Admitted = October 9th, 1899

Discharged = December 9th, 1899

(a) FAMILY HISTORY: - Father died of Heart Disease, Mother of Cancer. Home and surroundings good.

(b) HISTORY AND DESCRIPTION OF ULCER: - The patient has been a martyr to Sciatica and Rheumatism for many years, and has during the last six years suffered from Bronchial attacks every winter. She is very much run down in health and very anaemic. She does not remember injuring her leg in any way; but she first noticed about six years ago a hard dry scab on her leg, which peeled off, and left an ulcerating surface beneath it. This gradually increasing in size, she became very nervous and sent for the Doctor.

She was treated with Iodoform Ointment and Carbolic dressings, also took some tonic medicine internally. She also laid up at home for periods of several weeks at a time; but derived very little benefit, in fact the Ulcer seemed to get larger. She came up to London early in October to visit some friends, and then heard about the Oxygen Home, and was admitted as a patient on October 9th.

The Ulcer was a fairly extensive one, occupying the outer two thirds of the right leg. On admission the parts were treated as in the previous cases, and on the morning of the 10th the Oxygen was applied. At first 1/4 strength was used, i.e. 25%; but this was eventually raised to a 1/2,
i.e. 50%.
The condition progressed very favourably and she was discharged cured on December 8th.

On Admission
9th October. 1899

On Discharge.
8th December. 1899
CASE 6. MRS. ROSE. Age 42.

Residence = 91, Hood Street, Northampton.
Admitted = August 15th, 1899
Discharged = October 31st, 1899

(a) FAMILY HISTORY = Good. Comfortable home and good surroundings, fresh air and plenty of good food. Patient takes stimulants occasionally.

(b) HISTORY AND DESCRIPTION OF ULCER: Patient had an accident about three years ago, slipping on kitchen steps. She bruised the front of the lower part of left leg, and also the skin over the inside of left ankle. The parts sloughed leaving a large gap, discharging foulsmelling pus. The Ulcer was very painful and caused the patient great inconvenience. She attended at several dispensaries at Northampton, and latterly had several Doctors attending her, but received very slight benefit. She came up and was admitted on August 15th. On admission the leg was very much swollen, extremely tender and painful, and very foul smelling. She had Oxygen applied the following day, and from the start made very satisfactory progress. She was discharged cured on 31st October.

(See illustrations on page 91.)
On Admission.
15th August, 1899

On Discharge.
31st October, 1899
In most of the cases I noted that a cultivation taken the Ulcers on admission revealed microscopically a great variety of Rod Bacteria, some Diplococci, and very often Torula and Sarcinae, the latter organisms being chiefly met with in the foul and un Kemp Ulcers.

After about a week of treatment by cleanliness and Oxygen, it was noted from Cultures microscopically examined that the Rods and other Micro-organisms had been almost wholly displaced by some variety of Staphylococci. These latter being met with in all healing Ulcers, and Ulcers showing a tendency to heal, were consequently regarded as Beneficent organisms.

It was also found that the Rods and other unfavourable organisms returned again, if from any cause the patient felt poorly, this being especially noticeable in some of the female patients during menstruation.

Other Cultures were taken just before the patients were discharged, i.e. just before the Ulcer had completely healed, and in all cases a perfectly pure culture of some variety of Staphylococci were observed—proving that the Ulcer was healing up rapidly.

The Organisms met with in the healing stages of Ulcer were Staphylococci Pyogenes Albus, Aureus and Citreus.
CICATRICES OF HEALED WOUNDS AND ULCERS.

The nature of the Cicatrices, after the healing process is completed by Oxygen Gas has been found to be highly satisfactory. They have been found to be

1. Nearly analogous in appearance with the healthy skin surrounding the wound or ulcer.

2. They are vascular.

3. They are not contracted or puckered. The nature of the new skin tissue will be readily understood by referring to the accompanying micro-photographs.

The following is the Laboratory Report issued on the specimen by the Clinical Research Association.

"The sections of the tissue examined show that the specimen consists of epidermis and true skin."

"The epidermis is thick and possesses a specially thick layer of horny epithelium. This epithelium is of normal character, the stratum granulosum being well developed."

"The cutis is infiltrated to a considerable extent throughout with an exudation consisting of round and oval cells. The arrangement of these cells is in groups probably round blood-vessels, and in lines corresponding to the lymphatic vessels of the skin, it is also found in the papillae. "Most cells are present in considerable numbers in the neighbourhood of this exudation."

"The arrangement and character of the round cell exudation suggests some form of new growth of
"mesoblastic origin rather than the exudation of inflammation or that of any of the specific granulomata."

It will be seen by the foregoing and by examination of the micro-photograph that the new tissue is almost a true skin, it lacks only sweat glands and hairs to be so. The absence of these two structures proves its genuineness, and are conclusive negative arguments showing the new tissue produced by the Oxygen treatment in this case is a great deal more than an ordinary cicatrix, and a little less than true skin.
OXYGEN IN CASES OF OPIUM POISONING.

I have seen several cases of Opium poisoning very successfully treated by Oxygen Inhalations.

In a case treated at the Royal Infirmary, Glasgow, by my friend Dr. Baumann, it had a very marked effect in relieving the extreme cyanosis, and but for the prompt use of Oxygen the patient would most certainly have succumbed.

Unfortunately I never had an opportunity of putting the use of Oxygen to a practical test in these cases of poisoning.

So many eminent authorities, however, refer to its application in these cases with marked benefit to the patient, that it has quite established its place among the Therapeutic applications in these particular forms of poisoning.

Dr. Parrington reports the following case of Opium poisoning treated by Oxygen Inhalations:—

The patient, a drug clerk, took by mistake three drachms of Sol. Morphinae Sulphatis, on the morning of April 16th, 1873 at 7.30 a.m. When seen a few minutes later he was rapidly becoming comatose. A Physician was immediately summoned, and the various means of resuscitation were tried, flagellation, hypodermic injections of atropine Sulphate 1/30 gr. Enemata of hot coffee and brandy, and a galvanic Faradie battery applied.

He partially rallied, and again relapsed, cyanosis returned.
and respirations became superficial. Hypodermic Injections of whisky 30 m were given, and subsequently atropinae Sulphatis 1/30 grs and battery applied. In spite of this the patient still remained comatose and insusceptible to external impressions.

Oxygen was then administered by means of a dentist’s “laughing gas bag”, care being taken to admit some atmospheric air. During its administration some evidence of returning consciousness was manifested, the patient opening his eyelids and looking around vacantly; and immediately on removal of the bag relapsing into Coma.

A second bag was administered with similar results. After a third bag the patient became still more conscious. The action of gas being assisted by flagellation. A cupful of coffee was swallowed, and patient walked up and down the ward. By this means he was kept awake till 7 p.m. when though still drowsy, he was able to converse intelligently.

Unfortunately the following day he manifested symptoms of Pneumonia, and a week after admission died of double Pneumonia. Notwithstanding the fatal termination of case, I am fully convinced of the utility of the gas in cases of this sort.

(Phil. Med. Times 1872-73, p. 745)

After clearing the stomach, artificial respiration, and the Inhalation of Oxygen, and the application of warmth to the body and limbs are the chief and first means of restoration.

(Allbutt's System of Medicine Vol. iv. p. 880)
Inhalations of Oxygen have also been recommended and in many instances have proved of much service.

In addition to its usefulness in overcoming the cyanosis and stimulating the circulation, it is also supposed to exert a direct oxidising effect upon the poison. This idea has been suggested by the similar property of the Permanganate of Potassium; but as early as 1880 Dr. B.W. Richardson advocated the employment of Hydrogen Peroxide for the same purpose on account of the oxygen it contained

He directed it to be used subcutaneously, and by transfusion directly into the circulation, as well as by vaporising it and inhaling.

( Twentieth Century Practice of Medicine Vol.iii p.p. 551-552)

In conclusion I am quoting two cases— one of Lithiasis and another of Lenkaenia, successfully treated by the application of Oxygen Gas:

Dr. Kellogg reports the following case of Lithiasis, which was treated with great benefit to the patient by Oxygen ënemata. In one case the patient a man of 23 was passing great quantities of uric acid daily, a large quantity of crystals being thrown down from every specimen of urine passed. He was placed on a strict non-nitrogenous diet, and taking three to five pints of hot water; but the beneficial effects of either regimen was so slight as to
be scarcely perceptible.

Two litres of Oxygen were administered regularly each day about 10 a.m. At the end of three days, the excess of uric acid disappeared entirely from the urine, and has appeared only twice since, and then in small quantity when the injection had been discontinued for a day or two. At the beginning of treatment the patient's skin was very muddy, sclerotics dingy, tongue coated, and he complained of a very annoying brassy taste in the mouth, and distressing headache. The brassy taste and headache both disappeared soon after the injections were begun and there has been a steady improvement in every other particular. The coat has disappeared from the tongue, the skin and sclerotics have become nearly normal in appearance, and the patient has increased several pounds in weight, though before he had been losing weight for some weeks, and seems to be in every respect improved.

He also used Oxygen enemata in a case of Phthisis, the beneficial results arising from the use of the gas in this case being surprising. When the treatment was begun the patient had for some time had an evening temperature varying from two to three degrees above normal. The morning temperature was from 99° to 99 3/5° F. Within forty-eight hours after the use of the Oxygen was begun the temperature fell to normal, and did not rise above 99° at any time until about two weeks after the beginning of treatment when the febrile symptoms re-appeared as a result of an operation for the relief of troublesome
haemorrhoids following which the patient by imprudence contracted a slight cold.

(Therapeutical Gazette. Detroit. 1887. pp. 589 and 592)

Krinberger reports a case of Lenkaemia in a boy, which was successfully treated by Oxygen Inhalations:—

Jacob Koch, age ten and a half. Patient lives in bad hygienic surroundings. He had always enjoyed good health, until the summer of 1882, when his appetite became poor, and he complained of pains in the stomach. Various household remedies were tried by his mother without any good result, and as he was getting weaker and weaker, she consulted Dr. Krugg on the 5th of November. He found the youth looking very anaemic, the conjunctival and the mucous membrane of lips being quite colourless, Albumin was found in the urine. The patient also complained of a tightness in the chest. On examination a hydramia murmur was discovered in veins of neck and over heart. He was put on Iron treatment, but this did not improve him. He became very pale, appetite became poorer and the tightness in chest greater, and a constant feeling of weight in the abdomen. On examination the splenic tumour was found to be greatly enlarged being 8 c. m. in diameter.

Examination of the blood revealed diminution of red corpuscles and increase of the white corpuscles. Then put him on arsenic and its various combinations; but he did not take this well, and it had no good effects, he was then tried with stomachics alone; but as he gradually got
weaker, it was thought that possibly Oxygen might be of service, especially in increasing the appetite. The Gas was used with great success, far exceeding its expectations. Thirty litres of Gas were used daily, and after a few days the patient was able to take more nourishment and to retain it. He gradually got stronger and after ten days was able to leave his bed for a short time, the swelling of spleen gradually diminished. The examination of blood showed very slight improvement. Some time later about end of January the number of red corpuscles had risen to three million, the Leucocytes were not increased, and the spleen very slightly enlarged. The boy, who had been meanwhile using Oxygen Inhalations and arsenic, made so much progress that he was allowed up, and again attended school.

In spite of the slight swelling of Spleen Dr. Krügg examined the blood regularly every fortnight, the amount of red corpuscles exceeded four millions. About the middle of April the spleen got larger and by end of April was 12 c.m. in diameter. The red corpuscles had diminished to three million and the white had not increased (in each case the blood was examined by Gower's Haemocytometer) I then gave arsenic without Oxygen and by beginning of May had reduced the splenic enlargement from 12 to 7 c.m.; the red corpuscles had however not increased in number or colour and the boy still looked very pale. As the diminution of red corpuscles had established itself I again started Oxygen Inhalations. The condition improved rapidly and at present, the middle of September, the
swelling of spleen has entirely disappeared, and the
number of red corpuscles has returned to normal, and the
boy looks blooming, and to all appearance completely
cured.

( Zur Therapie der Lenkämien und Pseudo lenkämien-
Deutsche Medicinische Wochen Schrift 1833. p.p.594-598)

Lashkevitch has shown that Oxygen has the power of
markedly lowering excited reflex actions and suggested
that a trial of use in Puerperal Eclampsia might lead to
good results.
Favre and Uvoff have also used Oxygen Inhalations with
great success in cases of Eclampsia. It appears to be
very largely and successfully used by Russian Physicians
in cases of Eclampsia.

(Vrach. St.Petersburg 1835. VI. p.198)

I have not had an opportunity of testing its
application to any of these cases mentioned; but hope in
the future of doing so.
Oxygen has also proved of great value in cases of Ozoena
several cases having been very successfully treated at the
Oxygen Home. A case of Bronchectasis, and another of
Otorrhoea were also treated with great benefit to the
patient. In each case there was at first an increase of
the expectoration and of the discharge, which soon,
however, lost its foetid odour under the Oxygen application and eventually stopped entirely.

I could go on enumerating several other interesting cases in which Oxygen was successfully tried but I think the cases I have quoted are sufficient evidence of its usefulness as a Therapeutic agent.

I am anticipating great things for Oxygen in the future, and I see no reason why it should not be used with great benefit in staying the ravages of Phthisis, which are responsible for so great a yearly mortality in the United Kingdom.
PART II.

Experimental Research on Animals with Oxygen Gas.

[From the Department of Pathological Chemistry, University College, London.]
CONTENTS.

PART 2.

(1) INTRODUCTION.

(2) HISTORICAL RETROSPECT.

(3) EXPERIMENTAL METHOD AND DESCRIPTION OF EXPERIMENTS.

(4) CONCLUSIONS AND CONCLUDING REMARKS.
INTRODUCTION.

The very excellent results achieved with Oxygen Inhalations in cases of extreme cyanosis and Dyspnoea, and in most cases of Respiratory embarrassment, arising from either Cardiac or Pulmonary disease, suggested the idea that this Gas might possibly be used with great benefit and as a speedy means in the Process of Resuscitation of the partially asphyxiated.

Asphyxia, whether arising from the inhalation of poisonous vapours and drowning, or as a result of suffocation or strangulation, could I thought be very successfully and more readily combated by the employment and substitution of Oxygen Gas for ordinary air in the process of Resuscitation.

Accordingly with this end in view I conducted a series of some twenty experiments on Dogs, with the object of ascertaining:

(1) The limit to which the process of Asphyxiation could be carried, and the animal still be resuscitated by artificial respiration.

(2) The respective merits of Ordinary Air inflation and Oxygen inflation in accomplishing this end.

(3) The effect of substituting Air under pressure (compressed air in cylinders) for the ordinary air inflation, and comparing its value as a resuscitant as opposed to Oxygen.
As so many eminent scientists in all countries have been working at "Asphyxia" its pathology and treatment, I trust that my humble experimental efforts and investigations on this important subject will not seem very precocious. I do not wish to make any elaborate statements or to propound any new theories; but respectfully to submit to your notice a description of my experiments, the results obtained, and a brief statement of the inferences deduced from them.

Many important theories have been put forward as to what is the exact cause of death in cases of Asphyxia. Very interesting facts have been ascertained as to the effect of Asphyxia on the Heart and circulation by observers in France, Germany, Russia, and Italy who have been working at this subject.

In this country it has received due and careful attention at the hands of men like Mayow, Priestley, Beddoes, Erichsen etc, and our Alma Mater was not behind hand in contributing men like the Monroes; John Reid; Christison, Turner, and last but by no means least our talented and much lamented Professor of the Institutes of Medicine, the late William Rutherford.

After these few preliminary remarks, I shall next proceed to quote some of the literature bearing on the subject, and to briefly comment on it.
The effect of breathing Oxygen Air undiluted.

Dr. Priestley and M. Lavoisier found animals either to die or become exceedingly ill in such air, while it continues more oxygenated than the atmosphere, and will support the life of other animals. It is not the defect but excess of oxygen that is pernicious here. The heart and arteries pulsate more quickly and forcibly; the eyes grow red and seem to protrude; the heat of the body is said considerably to increase, sweat to break out over the whole body, and fatal mortification of the lungs to come on. These appearances denote violent inflammations: animals have always appeared to me to suffer extremely, soon after immersion in unmixed oxygen air. To my own lungs it feels like ardent spirits applied to the palate, and I have often thought I could not survive the inspiration of oxygen air from manganese by heat many minutes. The existence of inflammation is fully established by dissection, as others have found, and as appeared in the following experiments:

Two kittens were taken.
A. took pure oxygen air.
B. took ordinary atmosphere air.

After some time they were both drowned by immersion in water. They were then opened up.

In A Lungs and heart of a florid red colour. The edge of
one Lobe of Lung was marked by livid spots (as in mortification) The pleura was likewise evidently inflamed. The Liver, Kidneys, Spleen, blood vessels of mesentery and urinary bladder were of brightish red colour. In B. Heart was of deepish colour, Lungs pale, the Liver, Spleen, Kidneys, and Blood vessels in general were of a bluish or purple colour.

(Considerations on the Medicinal use of Facticious Airs- Beddoes 1794. p.13.)

The only explanation of the irritating effects and inflammatory conditions produced by the Oxygen, which he describes, is probably, I think, due to certain impurities in the Gas, derived from the manganese or other ingredients used in its manufacture. The oxygen we employ at the present time certainly does not give rise to these phenomena, even if inhaled in the pure state. Certainly I have never seen any bad effects following its use in any of my animals. The Heart, Lungs and other organs were certainly congested, and contained florid red oxygenated blood—there certainly were no other indications of inflammation anywhere. Upwards of thirty of my patients have been inhaling Oxygen without any deleterious effects arising—in fact, with only a few exceptions of slight headache, the majority describe that the inhalation of the Gas, gives rise to feelings of warmth in the chest, and a feeling of great freedom and comfort, producing a most exhilarating effect. No doubt can exist, I think, that the Gas employed by them contained impurities which gave rise to the symptoms mentioned—the newer and improved modes of
manufacturing the Gas at present, entirely dispels the noxious effects above described; in fact, its inhalation acts most beneficially in most cases.

Reddocks on account of the unfavourable symptoms arising from the use of pure oxygen, used it diluted with certain proportions of atmospheric air in the following experiments on dogs—:

Experiment with air, containing somewhat more oxygen than the atmosphere.

In my letter to Dr. Darwin, I conjectured that Divers would be able to continue longer under water, if before immersion they were to breathe air of a higher than the ordinary standard. I made several experiments to determine whether this supposition was just, in each two animals of the same litter were employed; as several spectators were sometimes present, they were desired to fix upon the weakest for oxygenation. The following report I literally transcribe from my journal, as it was settled and subscribed by the spectators. August 20th 1793.

Kitten C. was placed in a mixture of nearly two thirds oxygen air from manganese, and one third atmospheric air; it was kept twenty minutes in the vessel, which was from time to time supplied with Oxygene air, so as to keep the air better than atmospheric air, which was known by dipping a candle into it, and observing that it burned with a brighter flame. At the expiration of twenty minutes C, and D which had breathed atmospheric air, were immersed in
water till perfect asphyxia came on. At the instant they were taken out, there appeared in both a motion of the lower jaw, C began sensibly to recover, while D lay as dead. In a minute and a half C rose, and began to walk about the room staggering at first. D being still motionless or nearly so, in this state it continued for fifteen minutes, when for the first time, it raised itself and immediately afterwards fell on its side.

Signed. Cristopher Machell,
Richard Lovell Edgeworth,
J. Gullemand,
Jas. Saddler,
Thomas Beddoes.

Kitten D died the next day. Of the other similar experiments it is sufficient to observe that the result was always in some degree the same; sometimes the unoxygenated animal failed to recover; it was generally noticed that the oxygenated animal showed signs of life under water the longest, and sometimes that it struggled as much as ever after its unoxygenated fellow had ceased to move.

Another experiment was done on two greyhound puppies of the same litter, ten days old, E. the weaker was kept an hour and fifty minutes in a mixture of two thirds atmospheric air, and one third oxygen air from heated manganese. F was left as usual. Both were then immersed in Hydrogène air. F soon appeared much agitated, and expressed much uneasiness. E moved very little, and soon placed
itself in a couchant posture, with the head between the forelegs and the muzzle resting on the bottom of the vessel. In five minutes E was lying on its side, now and then breathing, which it did less and less frequently, and more feebly. In ten minutes this effort was scarce perceptible. In two minutes more it was not once repeated for the last six out of the twelve minutes E was so perfectly still, that we were disposed to believe it dead, and a person present said: "this experiment will turn out ill for the Oxygene". During these last six minutes E had not inspired at all, and from the first the respiration was very infrequent. At the end of twelve minutes both puppies were taken out of the Hydrogene air; E immediately cried and struggled F being quite motionless. They were laid before a fire; E cried, moved and soon walked as usual; F seeming quite dead. In fifteen minutes a stream of oxygene air was blown into F's mouth; but no sign of life appeared. The animal was afterwards opened; upon irritati-
ing the pericardium with a pointed knife, so as to press upon the heart, no movement followed, the pericardium being removed the heart began to contract spontaneously, a stream of oxygene air being directed on the heart, its action became more strong and frequent; the number of strokes was about seventy in a minute. The colour of the Heart (probably from the filling of its own blood vessels) changed from pale to red. The difference in the colour of tongues of these puppies was striking even by candle light, after the experiment that of E being much more ruddy.
The following variation of the experiment seems worth transcribing from the journal: of two puppies of the same litter, the weaker G was kept in atmospheric air mixed with one third oxygen and H for an equal time in atmospheric air with one third Hydrogen. Both were plunged into tepid water. H. became motionless while G moved with force, cried on being taken out, and seemed little affected. The effect of oxygen air was very striking in recovering H. it began to move and respire the moment it was put into a vessel containing this air. It was sometimes observed that the movements of very young puppies under water, did not entirely cease in less than fifteen minutes.

(Ibid. p.p.14-15.)

The above experiments performed by Beddoes prove conclusively that

(1) Animals that have respired Oxygen for some time (i.e air containing a higher percentage of Oxygen than ordinary air) are better able to resist asphyxiation than those that have only respired ordinary air.

(2) That oxygenated air has a most beneficial effect in restoring animation to the partially asphyxiated animal.

In one of my experiments the first point was very clearly brought out. The dog was asphyxiated and resuscitated by artificial respiration with ordinary air, then again asphyxiated and resuscitated by Oxygen; then asphyxiated once more and resuscitated by ordinary air.

I observed that it took much longer to asphyxiate the animal the third time after it had been twice resuscitated by Oxygen than after it had been once resuscitated by Oxygen.
resuscitated by Oxygen previously, than it did in either the first or second instance.

The second point I trust I have proved pretty conclusively, and fully established the fact that Oxygen acts much more beneficially than ordinary air as a means of Resuscitation. I consider that if Beddoes could arrive at such highly satisfactory results with the "impure oxygen" he employed in his day, that at present with a vastly superior and purer gas we ought to obtain equally good, and far better results.

Though vital air appears to have been first discovered by the sagacious Dr. Mayow, about the middle of last century; and though he described some of its most curious properties, yet the subject was unaccountably suffered to pass into oblivion, till lately it was fortunately revived by Dr. Priestley and others. From their observations, respecting its effects on the blood and respiration, I was led to consider, it is the cause of irritability, the principal agent in the animal economy, and therefore ventured, at an early period, to throw out some hints towards expediting its application to Medicine, and more particularly to the Theory of animation. The idea at length being adopted by others, has of late been offered as entirely new! Be this as it may, since vital air has been prosecuted with such uncommon ardour, it has given birth to some of the most brilliant discoveries which shed lustre on the present era.
From which we are now enabled not only to unfold the theory of respiration and animal heat; but also to explain many other curious phenomena both in health and disease. Among these, the following problems, which many years ago, I proposed under the form of queries, appeared to me to rest wholly on the properties of vital air.

Why vital air is an absolute necessity to the maintenance of life in the new born infant?

Why an animal, after its wind pipe has been divided, can be kept alive by inflating its lungs with air?

Throughout this paper he lays especial stress on the aeration and purification of the blood by vital air, and how it affords the most effectual antidote against the baleful effects of mephitic vapours, putrid animal effluvia, and other species of noxious air, which suddenly extinguish life. He goes on to describe a very interesting experiment performed by the eminent anatomist Professor Munroe:—He suspended a dog by the neck with a cord; an opening having been previously made in the windpipe below the cord, so as to admit air into the lungs. In this state he was allowed to hang three quarters of an hour, during which time, the circulation and breathing went on without being much interrupted by the experiment. The cord being now shifted below the opening into the windpipe, so as to intercept the ingress of air into the lungs and the animal being again suspended, was completely dead in a few minutes, proving that death in these cases is due to
exclusion of air from the Lungs, and not to apoplexy which theory had been previously held.

On summing up his paper Dr. Fothergill says, that in all cases of suspended animation, artificial respiration is an important part of the treatment of resuscitation, and ought to be performed at the beginning and pursued till natural breathing be re-established. He further states that he has found vital air (Oxygen) preferable to atmospheric air or air blown from another person’s lungs, for the purpose of artificial respiration.

(A new Inquiry into the Suspension of vital action in cases of Drowning and Suffocation—Fothergill 1794 p.p. 47-52-58)

Mr. Erichsen also utilised Oxygen with great success in his experiments on Dogs. He conducted nine experiments, and in four of these he found that Oxygen caused the Heart to act again after prolonged stoppages as a result of Asphyxia, varying from ten to twelve minutes. He used about three or four bladdersful of Oxygen to each experiment. He maintained that the highly oxygenated blood acted as a stimulant to the heart exciting it to contraction.

In these experiments then it was found that not only after the contractions of the ventricles, but also in some cases, those of the auricles, had fully and entirely ceased, the action of the heart could be restored by inflating the lungs with Oxygen Gas. And this it appears
to me, is a result of some importance, as regards the
treatment of Asphyxia. There can be little doubt but that
the revival of the contractions of the heart in these
cases was due to the very rapid arterialization of the
blood in the lungs, and its passage into the left side of
the heart before the irritability of that organ had
become so far extinct that it was unable to contract on
the application of the usual stimulus, and that the reason
why, by the inflation of the lungs with common air, it is
very difficult, if not impossible, to excite perfect
contractions of the ventricles, although tremulous move-
ments in them, and proper action of the auricles may be
set up, is, that the blood does not become arterialized
soon enough to reach the left ventricle, and to permeate
the tissue of the heart in sufficient quantity before that
organ has lost its power of contracting on the application
of this stimulus. It is true, that in several instances
in which inflation was set up as soon as the hearts action
had ceased, the contractions of that organ could not be
restored; the reason of which was not very obvious, though
I believe it to be connected with the age of the animal;
as I think I have noticed that the contractions of the
heart are more readily re-excited in the young than in the
old. The number of experiments that I have performed on
this subject amounting to only nine, we cannot draw any
conclusions from them as to the proportional number of
the cases in which recovery is likely to take place; but
nevertheless they are fully sufficient to establish the
fact, that the contractions of the ventricles may, after they have entirely ceased be re-excited by the inflation of the lungs with Oxygen Gas. Judging then, from the experiments on animals, the only data that we can safely go upon. I would earnestly impress upon the Humane Society the expediency of giving the inflation of the lungs with Oxygen a trial in cases of Asphyxia from submersion. I am the more earnest in this entreaty, as this gas had already been found by Dr. Babington, Mr. Morgan, and by a German Chemist, to be of use in the asphyxia from the inhalation of Carbonic acid, although in the cases reported, but a very small quantity of oxygen was used, and it was inhaled from a bladder.

In ordinary cases of submersion (those of the first category) in which the means at present employed are almost uniformly successful, it would be needless perhaps to have recourse to this means; but in those desperate cases in which submersion has lasted for more than four minutes, or in which there is no sign of vitality left, and in which, as has already been stated, the measures at present adopted are very generally ineffectual, I would most strenuously recommend the trial of the inflation of the lungs with Oxygen Gas, more especially as it would not interfere with any means at present employed. These are desperate cases, that are now almost necessarily fatal, and that consequently justify the employment of any remedy that holds out a reasonable hope of success.

(An Experimental Inquiry into the Pathology and Treatment of Asphyxia—Frichsen 1845 p.p. 50-53)
That which soonest brings the blood back to its normal colour, and so increases its stimulating action on the heart, will cause it to resume its contractions and again propel the blood into the arterial system.

This being the real state of the case, it necessarily follows, the sooner the black blood is made to experience its usual change in the lungs, the better chance there is for the recovery of the patient. This change is to be effected by air, then with regard to air we say—air from sound lungs—bonus; atmospheric air—melior; empyreal air (or as Dr. Priestley calls it Daphlogisticated air) optimus.

("Observations on animal life and apparent Death" Francks 1790 p.p. 76-77)

When pure Oxygene Gas can be procured, and the lungs inflated with it instead of common air, there can be no doubt of its superior efficacy. It can be conveniently carried to any requisite distance in an oiled silk bag, having a stopcock fitted to it, and this may be used instead of the bellows.

(" On apparent Death—Curry Jas 1815. p.52)

In all cases of great difficulty of breathing much relief may be conferred by administering pure Oxygen, such as may now always be obtained from Brin's Oxygen Company. It may be given, without danger,
undiluted, by means of a Cloven's Inhaler, or of a simple rubber tube and mouth piece; but in many instances it suffices to deliver a stream of the Gas close to the mouth.

(Allbutts System of Medicine p.351)

I could continue quoting several more articles by eminent authorities bearing on the subject, but shall for the present refrain from doing so, as I may have occasion to refer to some at a later stage in the paper.

After these introductory and preliminary remarks, I shall next proceed to the purport of this paper, and briefly describe the experimental methods I have used, the different results I have obtained, and shortly state the inferences deduced from these results.
The majority of animals used for the experiments, were Dogs, varying in weight between five and nine kilogrammes. As a regular respiratory rhythm was necessary in all cases, I utilised Ether as an anaesthetic, employing a stage of medium anaesthesia—such that the animal was not too deeply under to interfere with the breathing on the one hand; and not too slightly under on the other hand for it to struggle.

Tracings of the Respiration and Circulation were taken before, during and after the asphyxiation of the animal; and also during the process of resuscitation by

(a) Ordinary air versus Oxygen Gas.

(b) Compressed air versus Oxygen Gas

The respective merits of each means were carefully noted, and their value and efficacy individually observed. I shall refer to these fully after the description of the experiments.

(a) RECORD OF THE RESPIRATORY MOVEMENTS

After the animal had been fully anaesthetised, I made a vertical incision in the median line, carefully dividing all the muscular and connective tissue, and exposing the trachea just below the Thyroid gland. Any excessive haemorrhage being checked by forcipressure or sponging with boiling water. I next passed a threaded aneurism needle underneath the trachea, between it and
the Oesophagus, carefully avoiding the inclusion of any nerves.

The Trachea was then opened, and a Y shaped glass tube inserted. This arrangement excluded any mechanical obstruction to the respiration; whilst it at the same time greatly facilitated the regulation of the anaesthetic. To the one limb of the glass tube a short rubber tube was wired, having a funnel attached and communicating with the air. To the other limb of glass tube was fixed a long rubber tube leading off to the cylinders of Gas and compressed air.

Around that part of the chest which enlarges most during ordinary respiration, a Paul Bert's transmission apparatus, connected with a Marey's receiving tambour, was fixed by an inextensible band round the lower third of the Thorax. The tracings therefore represent the variations in the movements of inspiration and expiration of the lower third of chest. The upstroke in each case representing the change of circumference due to inspiratory distension of the chest from its position of equilibrium, the downstroke the return during expiration to the position of rest.

(b) RECORD OF THE CIRCULATION.

I next exposed the right common carotid artery, opening up the sheath, and carefully separating the vagus nerve from its inner and posterior surface. Then
two ligatures were passed between it and the nerve. The upper ligature was securely tied. The artery was then clamped low down and opened, a cannula inserted, which was securely tied in by the lower ligature—this was then placed in communication with a Franck's Mercurial Manometer. In this way the changes in the circulation were recorded.

(c) RECORD OF TIME = was taken by a metronome beating seconds, and recorded by an electromagnet. The recording points of respiration, circulation and time were kept vertically in line.

(d) THE RECORDING APPARATUS = The instrument used was the Kymographion of Hurthle. An idea of the apparatus used and their workings will be readily understood by reference to the accompanying diagram—:
**EXPERIMENTAL APPARATUS**

A = Hurthles' Kymographion.

B = Franck's Mercurial Manometer.

C = Cylinder of Compressed Air.
(An ordinary bellows was substituted for C in resuscitating by ordinary air)

D = Cylinder of Oxygen Gas.

E = Elastic Bag for holding the Gas, worked by pressure between two boards.

F = Paul Bert's transmission apparatus fixed to the chest by the inextensible adhesive plaster band.

G = Marey's Receiving Tambour with stile for recording the Respiratory movements.
H = Electromagnet recording the time in seconds.
I = Style recording the blood pressure, connected with
    Mercurial Manometer.
J = Cannula in Right common carotid artery, connected
    by tube with the Mercurial Manometer.
K = Tube in Trachea, with glass funnel at L for regulating
    anaesthesia.
L = Glass Funnel.
M = Tube leading from Trachea to Bag and Cylinders.
N = Tube conveying compressed air into bag.
O = Tube conveying Oxygen to Bag.
P = Saturated Sodium Carbonate Solution.
Q = Tube conveying the Soda Solution to Cannula.
R = Clock for regulating the movements of the
    Kymographion.
S = Metronome.
T = Three Bichromate cells.
U = Open end of tube on to which bellows were attached
    for ordinary air inflation.

The animal after being fully anaesthetised was tied
down on a board; the trachea exposed and opened. Next right
common carotid artery was exposed, opened and a cannula
inserted. The Cannula was then filled with saturated
sodium Carbonate Solution, the artery having been previously
clamped with a small bull-dog forceps. The level of
Mercury in the Mercurial Manometer was taken and recorded
(i.e) before the blood was let in. The bull dog forceps
was removed and the blood rushed into the cannula. The pressure in the Manometer was again taken and recorded.

The Kymograph was next set going, and a normal blood and Respiratory tracing taken. The animal was then asphyxiated by tightening the screw clamps of tubes K and M. When the respirations had completely ceased, and the blood pressure fallen to its lowest ebb, the clamps were unscrewed, and artificial respiration performed first with ordinary air inflation by means of a pair of bellows, the nozzle of which was fitted into the open end of tube M at U. The process of natural respiration was imitated as nearly as possible by inflating the lungs, and at regular intervals compressing tube K between forefinger and thumb.

When the animal had recovered and was breathing again, tube M was clamped, K being left open for the animal to breathe through. Next bag E was fixed on to tube M and placed in communication with Oxygen Cylinder. The bag at E was then filled with Oxygen.

A normal tracing was again taken, then K was clamped, and when the respirations had ceased and blood pressure had fallen as low as in the previous case, the clamps were unscrewed at K and M and artificial respiration performed with Oxygen in the same way as in the former case, only instead of bellows working the bag at E.

The time taken by the various modes of Resuscitation carefully noted, as also their effect on the respiration and Blood pressure.

It struck me that it would be interesting to see if there would be any difference by utilising compressed air
instead of ordinary air inflation, and comparing it with Oxygen Gas inflation.

I accordingly procured a Cylinder of compressed air, and arranged it as in diagram, utilising it in exactly the same manner as the Oxygen inflation, by first previously filling the Bag at A with the air, then unclamping and performing artificial Respiration by compressing the Bag at E between two boards working on a spring.

Unfortunately in all experimental work there are failures, and in my series of experiments, out of the twenty, nearly half or at least eight, were complete failures. This in some cases being due to certain imperfections in the working of the apparatus, which were unfortunately only detected during the course of the experiment; in other cases being due to carrying the process of asphyxiation too far, and placing the animal beyond any chance of being resuscitated. Often the blood in the cannula clotted at a most inopportune moment, and at a most critical stage in the proceedings, thus completely spoiling the experiment.

In spite of these failures, I have managed to obtain about a dozen fairly good results. Seven of these being done with ordinary air versus Oxygen Gas; and four with compressed Air versus Oxygen.

I intend to briefly describe six experiments, three of the former, and three of the latter, and by referring to the photographs of tracings accompanying each, the results achieved in each case will be readily seen—:
The animal employed in this experiment was a Fox-terrier dog weighing 8 Kilogrammes.
The preliminaries, fully detailed in a previous part of the paper, having been accomplished, a reading of the Mercury level in the manometer was next taken and recorded (i.e. before the blood was let into the cannula). The artery was next unclamped and the blood rushed into the cannula, the Blood pressure in the Manometer was then taken and recorded, this being done all through the various stages in the experiment.

The Kymograph was next set going and a normal tracing taken. By reference to the appended diagrams, the course of the experiment will be more readily followed:

--- ARTIFICIAL RESPIRATION with ORDINARY AIR ---

A = Numbers indicating the different stages in the Experiment.
B = Tracing of Time in Seconds.
C = Tracing of Blood Pressure.
D = Tracing of Respirations.
Level of Mercury in Manometer before Experiment = 0.

**Blood Pressure.**

<table>
<thead>
<tr>
<th>Manometer Reading</th>
<th>(a) Maximum</th>
<th>(b) Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16. to 6.</td>
<td></td>
</tr>
</tbody>
</table>

3. Cessation of Respiration and Circulation.

4. Artificial Respiration with Ordinary Air... 14. to 9.


The following table gives the time in seconds taken to asphyxiate the animal, the time during which the animal ceased breathing, and time occupied in resuscitating the animal by Artificial Respiration with Ordinary Air.

<table>
<thead>
<tr>
<th>Trachea Clamped</th>
<th>Cessation of Respiration</th>
<th>Artificial Respiration with Ordinary Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>61.</td>
<td>16.</td>
<td>10.</td>
</tr>
</tbody>
</table>
ARTIFICIAL RESPIRATION WITH OXYGEN GAS.

Level of Mercury in Manometer before Experiment = 0

Blood Pressure

<table>
<thead>
<tr>
<th>Manometer Reading</th>
<th>(a) Maximum</th>
<th>(b) Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18. to 8.</td>
<td></td>
</tr>
</tbody>
</table>

8. Cessation of Respiration and Circulation.

9. Artificial Respiration with Oxygen Gas...

<table>
<thead>
<tr>
<th></th>
<th>16. to 9.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20. to 19.</td>
</tr>
</tbody>
</table>

10. Breathing by itself....

Table indicating Time in Seconds occupied by asphyxiation, Cessation of respiration, and Artificial respiration with Oxygen Gas.

<table>
<thead>
<tr>
<th>Trachea : Clamped</th>
<th>Cessation of Respiration :</th>
<th>Artificial Respiration with Oxygen Gas :</th>
</tr>
</thead>
<tbody>
<tr>
<td>68.</td>
<td>14.</td>
<td>9.</td>
</tr>
</tbody>
</table>
Irish Terrier Dog weighing 5 Kilogrammes.

**ARTIFICIAL RESPIRATION with ORDINARY AIR.**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Normal tracing of Respiration and Circulation</td>
<td>17.5</td>
<td>16.5</td>
</tr>
<tr>
<td>2.</td>
<td>Trachea Clamped</td>
<td>17.5</td>
<td>16.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.5</td>
<td>15.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.5</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.5</td>
<td>12.5</td>
</tr>
<tr>
<td>3.</td>
<td>Cessation of Respiration and Circulation nearly.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Artificial Respiration with Ordinary air</td>
<td>13.5</td>
<td>9.5</td>
</tr>
<tr>
<td>5.</td>
<td>Breathing by itself</td>
<td>11.5</td>
<td>8.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trachea</th>
<th>Cessation of Respiration</th>
<th>Artificial Respiration with Ordinary Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clamped</td>
<td></td>
<td></td>
</tr>
<tr>
<td>82</td>
<td>66</td>
<td>37</td>
</tr>
</tbody>
</table>
ARTIFICIAL RESPIRATION WITH OXYGEN GAS.

Level of Mercury in Manometer before Experiment = 0

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>Manometer Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(a) Maximum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6 Normal tracing of Respiration and Circulation</th>
<th>17.5 to 16.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Trachea Clamped</td>
<td></td>
</tr>
<tr>
<td>8. Cessation of Respiration and Circulation.</td>
<td></td>
</tr>
<tr>
<td>9. Artificial Respiration with Oxygen Gas.</td>
<td>11.5 to 9.5</td>
</tr>
<tr>
<td>10. Breathing again</td>
<td>20.5 to 17.5</td>
</tr>
</tbody>
</table>

Trachea Clamped : Cessation of Respiration : Artificial Respiration with Oxygen Gas:
22 : 102 : 14
**ARTIFICIAL RESPIRATION WITH ORDINARY AIR.**

Level of Mercury in Manometer before Experiment = 0

**Blood Pressure.**

**Manometer Reading.**

(a) Maximum  (b) Minimum

1. Normal tracing of Respiration and Circulation... 18.5 to 18.
2. Trachea Clamped.................. 18.5 to 15.5.
   19.5 to 15.
   15.5 to 7.5.
3. Cessation of Respiration and Circulation.
4. Artificial Respiration with Ordinary Air 13.5 to 6.5.
   15.5 to 9.5.
5. Breathing by itself.............. 17.5 to 16.5.
   18.5 to 16.5.
   19.5 to 16.5.

Trachea : Cessation of : Artificial Respiration : Clamped : Respiration : with Ordinary Air :

68.  12.  60.
ARTIFICIAL RESPIRATION WITH OXYGEN GAS.

Level of Mercury in Manometer before Experiment = 0.

Blood Pressure.

Manometer Reading.

(a) Maximum. (b) Minimum.

6. Normal tracing of respiration and circulation. 18.5. to 17.5.

7. Trachea Clamped. 18.5. to 15.5.

8. Cessation of Respiration and Circulation.

9. Artificial Respiration with Oxygen Gas. 11.5. to 6.5.

10. Breathing by itself. 19.5. to 18.5.

Trachea: Cessation of: Artificial Respiration:

Clamped: Respiration: With oxygen Gas:

80. 10. 54.
EXPERIMENT XVII. No. 4.

Dog weighing 6½ Kilogrammes.

ARTIFICIAL RESPIRATION with COMPRESSED AIR.

Level of Mercury in Manometer before Experiment = 0

Blood Pressure.

Manometer Reading.

(a) Maximum. (b) Minimum.

1. Normal tracing of Respiration and Circulation . . 16. to 16.

2. Trachea Clamped. . . . . . . . . . . . . . . . . 20. to 14.

     19. to 14.

     18. to 14.

     18. to 11.

     17. to 8.

3. Cessation of Respiration and Circulation nearly.

4. Artificial Respiration with Compressed Air . . 13. to 8.

     16. to 15.

     21. to 19.

     21. to 16.

5. Breathing by itself . . . . . . . . . . . . . . . . 20. to 18.

Trachea : Cessation of : Artificial Respiration:
Clamped : Respiration : With Compressed Air
       60. 74. 10.
ARTIFICIAL RESPIRATION with OXYGEN GAS.

Level of Mercury in Manometer before Experiment = 0

Blood Pressure

Manometer Reading

(a) Maximum. (b) Minimum.

   21. to 10.
   11. to 9.
   10. to 8.

8. Cessation of Respiration and Circulation.
   19. to 17.
   21. to 18.


<table>
<thead>
<tr>
<th>Trachea Clamped:</th>
<th>Cessation of Respiration:</th>
<th>Artificial Respiration: With Oxygen Gas:</th>
</tr>
</thead>
<tbody>
<tr>
<td>65.</td>
<td>72.</td>
<td>20.</td>
</tr>
</tbody>
</table>
EXPERIMENT XVIII. No.5

Dog weighing 8 Kilos. 250. Grammes.

ARTIFICIAL RESPIRATION with COMPRESSED AIR.

Level of Mercury in Manometer before Experiment = 0.

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>Manometer Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Maximum</td>
<td>(b) Minimum</td>
</tr>
</tbody>
</table>

1. Normal Tracing of Respiration and Circulation. 16. to 15.
2. Trachea Clamped. 8.5 to 17.5.
   19. to 17.
   17. to 16.
   14. to 10.

3. Cessation of Respiration and Circulation.
4. Artificial Respiration with Compressed Air. 12. to 7.
   19. to 10.

   15. to 14.
   16. to 15.

<table>
<thead>
<tr>
<th>Trachea Clamped</th>
<th>Cessation of Respiration</th>
<th>Artificial Respiration with Compressed Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>65.</td>
<td>12.</td>
<td>21.</td>
</tr>
</tbody>
</table>
ARTIFICIAL RESPIRATION with OXYGEN GAS.

Level of Mercury in Manometer before Experiment = 0.

Blood Pressure

Manometer Reading.

<table>
<thead>
<tr>
<th>(a) Maximum</th>
<th>(b) Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Trachea Clamped</td>
<td>20.5 to 18.</td>
</tr>
<tr>
<td>19.</td>
<td>to 17.</td>
</tr>
<tr>
<td>17.5</td>
<td>to 15.</td>
</tr>
<tr>
<td>16.</td>
<td>to 14.</td>
</tr>
<tr>
<td>14.</td>
<td>to 12.</td>
</tr>
<tr>
<td>14.</td>
<td>to 10.</td>
</tr>
</tbody>
</table>

8. Cessation of Respiration and Circulation

| 16. | to 15.5. |
| 17. | to 16. |
| 18. | to 17. |

10. Breathing by itself | 17. to 16. |
| 16.5. | to 15. |

Trachea : Cessation of: Artificial Respiration: Clamped : Respiration : With Oxygen Gas:

90. 18. 21.
EXPERIMENT XX.  No.6

Terrier Bitch  Weighing 7 Kilogrammes

ARTIFICIAL RESPIRATION with COMPRESSED AIR.

Level of Mercury in Manometer before Experiment = 0.

---

Blood Pressure

Manometer Reading.

(a) Maximum  (b) Minimum

1. Normal tracing of Respiration
   and Circulation...  20.   to   21.

    22.   to   18.
    22.5.   to   18.
    20.   to   16.
    18.   to   12.
    14.   to    9.

3. Cessation of Respiration and Circulation.

4. Artificial Respiration with
   Compressed Air...  24.   to   22.
    23.   to   20.
    23.   to   19.
    23.   to   20.

5. Breathing by itself.
   23.   to   21.

---

Trachea:  Cessation of:  Artificial Respiration:
Clamped:  Respiration:   with Compressed Air.
76.   81.   40.
**ARTIFICIAL RESPIRATION with OXYGEN GAS.**

---

**Level of Mercury in Manometer before Experiment = 0**

<table>
<thead>
<tr>
<th>Blood Pressure</th>
<th>Manometer Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Maximum</td>
<td>(b) Minimum</td>
</tr>
</tbody>
</table>

6. Normal tracing of Respiration and Circulation... 23. to 22.5

7. Trachea Clamped... 23. to 20.

| 22.5. to 19. |
| 20. to 18.   |
| 17. to 13.   |
| 14.5. to 11. |
| 12. to 9.    |

8. Cessation of Respiration and Circulation.

9. Artificial Respiration with Oxygen Gas... 34. to 24.5.

| 34. to 24.   |
| 29. to 22.   |
| 29. to 24.   |

10. Breathing by itself... 29. to 24.

<table>
<thead>
<tr>
<th>Trachea Clamped</th>
<th>Cessation of Respiration</th>
<th>Artificial Respiration with Oxygen Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>80.</td>
<td>87.</td>
<td>20.</td>
</tr>
</tbody>
</table>
Before proceeding further I shall just briefly recapitulate the tables at the end of each experiment, and arrange them in tabular form, as by this means the time occupied by each part of the experiment, and the respective values of ordinary and compressed Air resuscitation versus Oxygen gas resuscitation, will be able to be more easily compared and more readily appreciated.

### Tables

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>61</td>
<td>12</td>
<td>10.</td>
<td>88</td>
<td>14</td>
<td>8.</td>
</tr>
<tr>
<td>II.</td>
<td>82</td>
<td>88</td>
<td>37.</td>
<td>92</td>
<td>102</td>
<td>14.</td>
</tr>
<tr>
<td>IV.</td>
<td>66</td>
<td>12</td>
<td>60.</td>
<td>80</td>
<td>10</td>
<td>54.</td>
</tr>
<tr>
<td>Total</td>
<td>211</td>
<td>94</td>
<td>107.</td>
<td>240</td>
<td>126</td>
<td>77.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IV.</td>
<td>60</td>
<td>74</td>
<td>10.</td>
<td>65</td>
<td>75</td>
<td>20.</td>
</tr>
<tr>
<td>VII.</td>
<td>65</td>
<td>12</td>
<td>21.</td>
<td>90</td>
<td>18</td>
<td>21.</td>
</tr>
<tr>
<td>V.</td>
<td>76</td>
<td>81</td>
<td>40.</td>
<td>80</td>
<td>87</td>
<td>20.</td>
</tr>
<tr>
<td>Total</td>
<td>201</td>
<td>167</td>
<td>71.</td>
<td>245</td>
<td>164</td>
<td>61.</td>
</tr>
</tbody>
</table>

### Averages

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>IV.</td>
<td>70.8</td>
<td>31.3</td>
<td>35.9</td>
<td>80</td>
<td>42.4</td>
<td>25.3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>V.</td>
<td>67</td>
<td>55.8</td>
<td>23.8</td>
<td>81.8</td>
<td>61.8</td>
<td>20.8</td>
</tr>
</tbody>
</table>
CONCLUSIONS AND CONCLUDING REMARKS.

(a) Conclusions.

The effect of Asphyxia on Circulation and Respiration;-

It will be readily noticed by reference to the photographs of tracings and the Manometer readings — that immediately after the Trachea is clamped, and the process of asphyxiation started — the blood pressure gradually begins to rise. The animal at the same time makes deep Inspiratory efforts, each being sustained for a time, and expiration is followed by a fresh forcible inspiration. The blood pressure shows variations corresponding to these respirations. The animal then passes into a rapid series of convulsive struggles, as seen upon the respiratory tracing, and with each struggle the blood pressure rises considerably. The mean blood pressure reaches its greatest height during this stage — after this there is a gradual weakening and slowing of the heart and a fall in the blood pressure — the animal becomes quiet, and only a few respirations are attempted. No other muscular efforts are made. The heart gradually ceases to beat, and when there is complete cessation of Respiration and Circulation, and the animal is to all appearances dead, artificial Respiration is started.

By consulting the foregoing Tables, it will be seen how far superior Oxygen Gas is to ordinary Air as a Resuscitant. In all my Experiments without a single
exception, the asphyxiated animals were more quickly resuscitated by this Gas, than by inflation with ordinary Air.

With regard, however, to the respective merits of compressed Air versus Oxygen Gas, there is in my opinion very little, if any difference at all. They both act equally quickly and equally beneficially in the process of Resuscitation. On the whole, perhaps, Oxygen acts slightly quicker. In most cases I have noticed that the dark blood in the cannula after asphyxiation, sooner assumes the bright arterial red colour under Oxygen Gas Inflation, than it does under compressed Air Inflation. The animal appears to me to breathe more freely and with less effort after Oxygen, and the Respiration curve sooner assumes the normal again under the use of this Gas.

Another interesting point that I have referred to in an earlier part of the paper is that it took ever so much longer to asphyxiate the animal after it had been previously resuscitated by Oxygen - in most cases it took nearly twice as long as it took to asphyxiate the animal after ordinary or compressed air inflation.

In trying to explain the reason of this from my point of view, I am afraid I shall venture on very dangerous and disputed ground; before doing so, however, I shall just quote the following, as it bears on the subject:—

"Considerable discussion has arisen concerning the effect of an increased percentage of Oxygen in the air breathed, upon the respiratory exchange, Is there, or is there not an increase in the absorption of Oxygen, and the discharge of Carbon dioxide under these conditions?"
Many observers maintain that there is a distinct augmentation of the Metabolism of the body, others find that the Respiratory exchange of a normal animal is the same in amount, whether it breathes air or pure Oxygen. Without entering into a discussion of the numerous contradictory answers to this question, it is permissible to draw the following conclusions:— The normal animal does not increase its respiratory exchange when it breathes pure oxygen instead of air, for its metabolism is regulated by the needs of its tissues, and not directly by the amount of Oxygen absorbed in the lungs; in the case of some diseases, during which the blood, owing to its diminished absorption of oxygen in the lungs, is abnormally venous, the breathing of pure Oxygen would increase the percentage of oxygen in the alveolar air, and thus enable the blood in the lungs to take up more oxygen. In these cases breathing oxygen under pressure greater than that of the oxygen in the air would for a similar reason, be effective, and would also increase the amount of Oxygen simply dissolved in the plasma.

It would appear, therefore, that there is strictly no contradiction in most of the experimental and clinical results, for in the normal animal breathing ordinary air the arterial blood is almost saturated with Oxygen, and without doubt contains as much or more oxygen than the tissues need. This is certainly not the case in some diseases during which the patients have derived benefit from breathing Oxygen.”

Physiologists have conclusively proved that the red corpuscles in the blood are the great storers and conveyers of Oxygen Gas to the tissues.

The Haemoglobin of the red corpuscles enters into combination with the oxygen and retains it, till it either gives it up to the tissues or gets it displaced by Carbonic Acid Gas.

1. The most convincing proof of this was furnished by Hoppe-Seyler, who succeeded in crystallising Haemoglobin and showed that it combined with Oxygen; but yielded up the gas to a vacuum.

1. (Text Book of Physiology - Vol. 1 Schäfer. p.766)

I am of opinion (1) that after asphyxiation the animal takes in a larger amount of pure oxygen - thus having a large amount of complemental air in its vesicles containing a larger percentage of oxygen than ordinary air.

(2) That the Oxygen in its pure state combines more readily with the Haemoglobin of the blood, than does the Oxygen contained in solution in ordinary or compressed air. This probably accounts for the more rapid arterialization of the black blood in the cannula during resuscitation with Oxygen.

(3) That the pure Oxygen forms a more stable compound with the Haemoglobin than the oxygen in solution with air does - this may possibly be the reason why it takes so much longer to asphyxiate the animal after it has
once been resuscitated by this Gas - the Haemoglobin parting more slowly with its oxygen.

After the completion of the experiment the animal was killed instantaneously by pouring chloroform down its Trachea. A Post Mortem was then made in each case.

It was found that in animals that had died during the process of asphyxiation, and that failed to respond to resuscitation by any of the means employed, that, (1) the right heart was distended with black blood, which was clotted in some cases, while the left side of the heart was comparatively empty. The Lungs and other organs were engorged with dark blood.

In cases where the animal was killed after having been previously resuscitated by Oxygen Gas - the right heart was distended by Red arterial blood, the lungs engorged with bright scarlet blood and the same conditions were observed in the other organs, liver, Kidneys etc.

In several of the cases, the contractions of the heart were visible for some time after death. After the chest had been opened and the heart exposed, the contractions of the auricles were clearly visible. Often these contractions were initiated by puncturing the Right Venticle.

\[\text{(b) CONCLUDING REMARKS.}\]

In conclusion I shall just briefly state my opinion of the respective merits of the different Resuscitants employed in the Experiments - and shall adopt Dr. Francks'
summing up (see p. 14) by stating it as follows—:

**Ordinary Air** = Bonus.

**Compressed Air** = Melior.

**Oxygen Gas** = Optimus.

I agree with Mr. Briehsen in saying that the Oxygen Gas should most certainly be used in those very bad cases, where other means of Resuscitation completely fail. With the present cheap rate at which this gas is manufactured and sold, I think it imperative that every Life Saving Station should have several Cylinders on hand ready for use; especially as it has been shown to be so vastly superior in its action to Artificial Respiration with ordinary air.

Unfortunately we are rather too reticent in adopting new methods, and prefer holding fast to the old ones; but surely where a Human Life is at stake, we should forego some of these scruples, and use that particular means which holds out the best chances for restoring animation to the apparently dead or dying.

**Oxygen Gas** is the life maintaining element in the animal kingdom — why should it not also play an important part as a Life-restoring Agent?.