

Fig. 1
An Attempt *Fig. 3*
at
an Historical Survey
of
Life-saving Measures
for Drowning Persons
and
Information
of the Best Means

by Which They Can Again Be Brought Back
to Life
by

J. D. Herholdt and C. G. Rafn

With a Copper Engraving

Copenhagen, 1796

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1796
[1960]
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CORRIGENDA

Unfortunately, the page numbers cited in the *Foreword* refer to the original Danish version and should be changed as follows:—

Page III

Line 17: For 56–57, read 42

Line 21: For 59–62, read 44–47

Line 5 from bottom: For 69–70, read 52–53

Page IV

Line 10 from bottom: For 62–65, read 47–52

Last line: For 52 and 65, read 39 and 49

Page V

Line 1: For 65–66, read 49

Line 4: For 66–69, read 50–52

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To Dr Ralph Waters
from the grateful pupil
Eric Nilsson

Foreword

From time immemorial, great interest has attached to resuscitation of asphyxiated subjects.

The large amount of literature on artificial respiration in the form of mechanically performed pulmonary ventilation, which since the middle of the eighteenth century has occupied a central position among the methods of resuscitation, was analysed by H. ENGHOFF (1956)⁷.

Among the pioneers who introduced manual methods for artificial respiration may be mentioned H. R. SILVESTER (1857)²², E. A. SCHAFER (1904)²¹, and HOLGER NIELSEN (1932)¹⁵. The last of these methods seemed to be more effective than any previously known (E. LUNDSGAARD (1935)¹⁴, E. ASMUSSEN and M. NIELSEN (1950)¹, A. S. GORDON et al. (1950, 1951)^{8, 9}, P. V. KARPOVICH et al. (1951)¹³, R. G. NIMS et al. (1951)¹⁶). On the basis of the investigations just mentioned, the Holger Nielsen method was first introduced in Denmark and later in a number of other countries (E. VON HOLSTEIN-RATHLOU (1957)¹².

However, during recent years attention has been focused on an ancient respiration method, the so-called insufflation (mouth-to-mouth or mouth-to-nose) method consisting in intermittent inflation of the apnoeic victims's lungs with the rescuer's expired air. Direct mouth-to-mouth resuscitation, which is often referred to as the "Biblical method" (THE BIBLE²), was described in detail in the present book

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by J. D. HERHOLDT and C. G. RAFN as early as 1796. The method was later recommended by R. M. WATERS et al. (1936, 1943)^{24, 23}.

Comparative studies on the effectiveness of the insufflation methods and the manual methods performed on human subjects under controlled experimental conditions have only been published during recent years (P. SAFAR et al. (1958)^{19, 20}, A. S. GORDON et al. (1958)¹⁰, H. POULSEN et al. (1959)¹⁷). These investigations showed that the methods of manual respiration in common use often fail in practice because of obstruction of the airway, and that considerably larger ventilation volumes can be obtained by the insufflation method. The results of these investigations were so convincing that the insufflation method was accepted both in North America and in Europe (D. B. DILL (1958)⁶, O. VON DARDEL and O. NORLANDER (1958)⁵, G. HAGLUND (1958)¹¹, H. RUBEN (1958)¹⁸.

At the present time it may be claimed that the mouth-to-mouth method, if it is performed correctly, is a satisfactory method for rescue breathing. Opinions are hardly divergent on this point. The discussion now is more concerned with the problem whether it should be recommended as the only method, or whether an attempt should be made to teach the layman to use both this method and a manual method, such as that of Holger Nielsen.

In the discussion of this problem a number of questions must be considered, for example: (1) Can the respiration method used produce adequate alveolar ventilation? (2) Can it maintain a free airway? (3) Can it be taught to the layman? (4) Can it be applied to all categories of patients? (5) What influence does it exert on circulation? In addition, (6) certain psy-

chological factors must be considered (e. g., if the layman is a willing to learn the method in practice).

All over the world these problems have been discussed by anaesthesiologists and life-saving institutions. The question as to the best method of resuscitation on the scene of the accident remains unanswered, but is of vital importance to all of us.

It may therefore be of interest to read what two Danish scientists, J. D. HERHOLDT and C. G. RAFFN, wrote on these problems in 1796. A modern anaesthesiologist who reads their book on *Live-saving Measures for Drowning Persons* will be surprised. He will see that the main principles of modern anaesthesiology have their roots far back in the past.

The importance of the restoration of adequate respiration in an apparently drowned person is emphasised on pages 56–57, where the authors say that:

. . . Above all, the Arrested Respiration should be started again.

The mouth-to-mouth method is carefully and vividly described on pages 59–62 in a section entitled:

. . . Insufflation of Air into the Lungs.

The description is so lucid and brief that it may serve as a model for modern scientific papers, and it emphasises the advantages and disadvantages of this method.

Airway obstruction as a serious complication during resuscitation is dealt with on pages 69–70, where water and other foreign bodies as well as the falling back of the tongue and laryngospasm are mentioned as causes of such obstruction. During their review of the treatment of airway obstruction both tracheal in-

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tubation and tracheostomy are mentioned. For tracheal intubation they recommend:

. . . the introduction of a curved Tube, similar to a male catheter, into the windpipe.

The technique of intubation is described in detail, and it is briefly mentioned that:

. . . this procedure is not difficult to perform.

As regards tracheostomy, the authors write that:

. . . this operation consists in making an incision into the Windpipe on the anterior aspect of the Neck, through which air can be inflated into the Lungs. It should be done only by a Doctor, and it is described in all Text-books of Surgery.

The section on tracheostomy ends with a remark which is of considerable interest:

. . . For the reassurance of the Common People we may add that Tracheotomy is far less dangerous than was previously believed.

A more advanced form of mechanical artificial respiration is considered on pages 62–65, where GORCY's and JOHN HUNTER's ventilation apparatus, consisting of a double bellows, is described. The authors apparently took great interest in this apparatus, which is described in great detail. Functionally, it is actually a resuscitator employing the principle of intermittent positive and negative pressure.

HERHOLDT and RAFN emphasise repeatedly (e.g. pages 52 and 65) the importance of oxygen in

attempted resuscitation. On pages 65–66 they consider:

. . . the excellent utility of unmixed Vital Air (oxygen) as a means of animation for seemingly Drowned Persons. It is, indeed, an incontestable Truth that the power of the Atmosphere to maintain respiration is exclusively due to its having this gas as a constituent element. Does not this directly lead to the conclusion that Vital Air must possess the animating property of the Atmosphere to a still higher degree?

In order to be able to utilise oxygen in connexion with the above-mentioned resuscitator, certain modifications of the apparatus were suggested (pages 66–69), so that it could be used for artificial respiration with pure oxygen or atmospheric air as desired.

In addition, the authors considered the importance of carbon dioxide in relation to respiratory insufficiency. We anaesthesiologists of 1960 must therefore admit that HERHOLDT and RAFN, more than 160 years ago, in an admirable way shed light on the principal problems within our special field which we are facing every day in the treatment of our patients.

Who then were these two scientists?

JOHN DANIEL HERHOLDT was born in Aabenraa, Denmark, on July 10, 1764, and died in Copenhagen on February 18, 1836. In 1785, he took an examination at the *Theatrum anatomico-chirurgicum* in Copenhagen and during the following years was a surgeon in the Navy.

In 1793, the University of Copenhagen set its first annual prize essays, and it came as rather a surprise

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when the Medical Prize was won by HERHOLDT, who had not matriculated at the University. HERHOLDT had taken private lessons in Latin, and his essay was considered so good that it was decreed that he should be awarded the Prize. Three years later, although he had still not matriculated, he applied for the vacant professorship in anatomy at the Faculty of Medicine, but was not appointed.

In 1798, he became a member of the Royal Danish Academy of Sciences and Letters, but only in 1802 did he matriculate, and in the same year he received his medical doctorate. He became *Professor Extraordinarius* in 1805, Senior Medical Officer to the Fleet in 1806, member of the Board of Health in 1808, *Professor Ordinarius* (in Medicine and later also in Medical Physiology) in 1818. He was Senior Physician at Frederiks Hospital 1819–1825 and Rector of the University 1819–1820 and again 1834–1835.

HERHOLDT's published works covered a wide field. He dealt with all the discoveries which appeared at that time in excellent surveys, often in collaboration with RAFN. He is therefore a figure of great importance in the development of the science of medicine in Denmark.

CARL GOTTLÖB RAFN was born on July 31, 1769, in Viborg, Denmark, and died in Copenhagen on May 17, 1808. He matriculated at the University of Copenhagen in 1788, where he studied medicine, veterinary science and botany, but he did not take any final examination.

He was extremely versatile and intelligent and made considerable scientific contributions, which exerted an influence on the development within all those fields in which he took an interest.

In 1797, he entered the central administration, where he became assessor in the Ministry of Agriculture and Commerce. In 1801, he also became a member of the Royal Inspectorate of Factories, and in 1804, commissioner in this Ministry (Production and Fisheries Section). He was the co-editor of the journal "Handels- og Industritidende" of that institution until his death. In 1804, he was also appointed director of the Royal Aquavit Distillery in Sølvgade.

Considering the wide range of RAFN's activities as a government official and his short span of life, his written works are certainly impressive.

His most important scientific contributions probably fall within the field of botany, but he also dealt with medical, physical, chemical and mineralogical subjects in a number of works. Through the clarity of these original and well-founded treatises, he greatly influenced the practical application of science in veterinary medicine, agriculture, horticulture, technology, industry, etc.

HERHOLDT and RAFN, who were close friends, published the present book, *Life-saving Measures for Drowning Persons*, in 1796, thus giving an impetus which resulted in the foundation of the *Society for the Rescue of Drowning Persons* in the same year. The two authors continued their scientific collaboration, and in 1805 were jointly awarded the prize given by the French *Institut Nationale* for a treatise on the hibernation of certain animals and related phenomena.

In their collaboration HERHOLDT dealt with the theoretical aspects—and RAFN with the practical. The Professor of Medicine and Physiology, and the practical, scientifically trained, versatile Government

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Official supplemented each other in a way which could well serve as a model.

Together they stand as a token of the valuable, centuries-old tradition within Scandinavian medical science. They took up vital problems for critical analysis and evaluation, reported their findings in a clear and objective fashion, and also ensured that the patients themselves would derive benefit from the experience gained. They pointed the way forward towards the methods used to-day in anaesthesiology and resuscitation.

Our scientific association, *the Scandinavian Society of Anaesthesiologists*, was only founded 10 years ago; nevertheless, as already suggested, the clinical and scientific work of its members is based on a centuries-old tradition. We regard the scientists who established the foundation upon which we stand to-day with respect and admiration.

Consequently, it is a great pleasure to acknowledge the financial support given by *Leo Pharmaceutical Products*, Copenhagen, which made it possible to reprint J. D. HERHOLDT and C.G. RAFN's book and to distribute it as a gift to Scandinavian anaesthesiologists on the occasion of its tenth anniversary.

In order that colleagues from outside Scandinavia may also benefit from the book, it has been translated into English by collaboration between Mr. DONALD W. HANNAH, M.A., Lecturer in English at the University of Aarhus, and Mr. A. ROUSING, M.T.F., Aarhus. I wish to express my deep gratitude for the extensive and exacting work this has entailed, particularly by the task of rendering the translation as closely as possible into the language and idiom of late eighteenth-century English.

I also wish to record my warm thanks to Dr. M.H. ARMSTRONG DAVISON, Newcastle upon Tyne, for his advice and suggestions when reading through the English version of the book.

Aarhus, June 1960.

HENNING POULSEN

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Printed at H. Tikiøb's, Bookseller,
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The President of the Exchequer .

Privy Councillor

Count Christian Reventlov

Friend of the Fatherland

Promotor of Arrangements for the Common Weal

Spokesman of the Humble People.

To
The Archiater
Professor Philipp Gabriel Hensler
and
The Court Physician
Professor Johan Clemens Tode
Both Distinguished
by
Rare Talents and Knowledge,
Ardent Zeal in the Art of Medicine
and Solitude for the Rescue
of Asphyxiated Persons

Is This Attempt Dedicated
with Reverence and Veneration
by
The Authors

PREFACE

In the leisure hours which we sometimes devoted to friendly intercourse, it was our dearest Pursuit to tell and exchange with one another what each of us had collected by conversations with Learned Men, by reading, or by our own Experience. Of late, the newer discoveries in Natural Science particularly attracted our attention. Often had we occasion to rejoice in the extensive aims of the researches of the Human Spirit; often in the Ingenuity which shone in Research itself; still deeper was our Rejoicing when we found a discovery applied to the Public Weal. Never did we forget that this ought to be the aim of all our Endeavours.

But among the several subjects, the Study of which was our desire, none appeared to us to be so important as the Mode of Death of Drowning Persons, and the means by which they could again be brought back to life. No other matter did we take more closely to our heart; nothing touched us more nearly than the fate of these unfortunate people in our fatherland. We imagined this particular discipline of Medical Art proceeding—going hand in hand with Natural Science—towards Perfection. We saw the Lover of Mankind in distant countries taking an active part in the rescue of Asphyxiated Persons. We saw measures which honour Humanity itself appear even among ignorant peoples and being applied with un-

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expected, almost incredible Success. But not without Sorrow did we see the lack of warmth with which this subject was regarded in our own native land. Admittedly, a few Decrees showed us that the Government did not fail to appreciate the Importance of this Matter, and that it regarded it as the duty of the State and every Citizen to come to the rescue of such Victims. A few Endeavours made by Scientists assuredly bore witness to the fact that these had found the matter to be of unusual interest; but this was almost all that we found had been done.

Therefore is it very seldom that we hear in this country of a Drowned Person being given back to the State. This, in its turn, entails the sad consequence that the *older* Physician, whose time does not allow him to familiarise himself with the Success which these public life-saving measures obtain in Foreign Countries, far too easily conceives a distrust of what Medical Art by proper and persevering treatment can attain in such cases; and that the *younger* Physician, who during the number of years in which he fitted himself for his important calling may not even once have had an opportunity to see a Drowning Person being saved, nor of hearing his Teachers, *ex cathedra*, from their own Experience and with Ardour, praise the means which had rendered assistance. Therefore the young Physician reasonably holds the opinion that all aid from Medical Art is in vain. In this way does this lack of interest takes us constantly farther away from the Goal.

The Thought of this is the more Melancholy because the Gazettes almost every week announce that now one, now another member of the State has died by drowning.

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If we assume that about 45 people are drowned every year in this our Capital of Copenhagen, and if we imagine that we had here a public institution like that in *London*, simple Calculation would show that this might save the lives of 30 fellow Townsmen. Suppose that each of these persons might live another 20 years; hence it follows that the number of the inhabitants in Copenhagen within the space of 20 years would be increased by more than 600 people besides their offspring, and that these, merely reckoned on a cameralistic basis, would yield to the State better return than the Life-saving Measures would cost.

As many Fellow Creatures as these has the enlightened, otherwise so charitable Copenhagen allowed to perish in bygone ages; but we do not say that this is because it has no regard for human life, but rather because it has believed that other Subjects have greater demands on its Charity.

We wish that this imperfect Attempt might contribute to arouse Good Will in our wealthy Fellow Citizens so that they become intent on a Public institution; we wish that the Examples which Foreign Countries present to us and the Thought of the increasing perfection of Medical Art might stimulate this Good Will readily to bring Succour! Then we confidently hope that Men inspired by Love to our Fatherland will direct the Attention of our Government to this Matter and provide the requisite Authority and Aid.

The 1st Septb. 1796.

C. G. RAFN J. D. HERHOLDT

*Survey of the Progress in Life-saving Measures,
Especially during Recent Times*

Up to the middle of this century little had been done to contribute to the rescue of Drowning Persons. Admittedly, older Physicians had tried to widen this domain of their Science but, as History shows, with only moderate success. Nowhere had public measures been taken. The first fortunate time began in the year 1767, and to the Dutch principally belongs the credit for the first serious attempt to take care of these their unhappy Brethren. It was in that year that a number of townspeople in *Amsterdam* resolved themselves into a Society under the name of *Maatschappij ter Redding der Drenkelingen*, partly in order to give instruction, partly to give appropriate rewards in order to encourage the People to make common use of the Life-saving Measures known at that time.

On the 24th of August of the same Year this Society caused to be published some letters concerning this matter in the issues Nos. 86, 88, and 94 of the weekly journal called *Philosophen*. In these letters the Society offered:—

1. To award a prize of 6 Ducats to any one living in the provinces of the Netherlands, be he a Physician or not, who could prove that he had rescued an adult or child who without movements or other signs of life had been saved from the water. Alternatively, they would award a commemorative Gold Medal bearing

the name of the person who had performed this Humane Deed.

2. To reimburse the moneys which might have been spent in the rescue of such persons, up to the sum of 4 Rd., irrespective of whether the Victim by this had been restored to life or not, if only it could be proven that the sum in question had been spent on that purpose.

In the same letters the Society also proclaimed the Means which it considered to be the most appropriate in restoring the Drowned to life. It attempted to root out the deep-seated Prejudice which persisted of regarding everybody whose body did not show signs of putrefaction as being really dead, and warned against the use of the older, both harmful and absurd, Life-saving Measures, such as rolling the drowned person over a Barrel, hanging him up by the Legs and other suchlike Acts of Maltreatment.

However, as the Objective of this was not achieved, partly because the cause had not been made sufficiently known and partly because of the prevailing Prejudice against taking into one's House anybody who did not show signs of life, this induced the Society, on the 16th of December 1767, to publish an extract from this Announcement, of which the Society not only distributed 6000 copies in the various provinces of the country, but also had it posted publicly in Amsterdam and in other places, and used all possible Diligence to bring it into the hands of the Humble People.

Thus, this Society set an example in all the provinces in the Netherlands. A consequence of this was that some Lovers of Mankind in *Rotterdam* offered another reward of 6 Ducats to any one who rescued

a Drowning Person in that City. At about the same time, a public announcement was issued in *Utrecht*, under which the Physicians were allowed to cause the Drowned to be taken from the Water—and even though they did not show signs of life—to have them carried into any neighbouring house and there use everything for their Recovery. In the same announcement, it was specifically forbidden innkeepers to oppose such measures, under a penalty of 25 Guldens.

In *Deventer*, the announcement of this Society was reprinted and read in Public Places, and certain Rewards were added, intended for those who rescued the Drowned or first lodged Information that somebody had fallen into the water. Similar measures were taken in *Geldern*.

On the 26th of November 1768, the Society published a report on 19 Victims, only in the Dutch provinces, who had been saved by the recommended Measures within the space of 14 months*). None of these had shown the slightest sign of life when they were taken from the water, and those present considered most of them to be completely dead. By this, several noble-minded Dutch Citizens were encouraged to request the Society to accept Donations from them for the promotion of this Good Work, which gave rise to the Proposal to form a Tontine consisting of 400 shares each of 250 Guldens, which thus made a capital of a total amount of 100,000 Guldens. Out of the annual interest on this Sum, the Society was to retain one quarter Part to defray the Costs and the

*) Geschichte und Urkunden der im Jahre 1767 zur Rettung der Ertrunkenen zu Amsterdam errichteten Gesellschaft. Hamburg 1769.

remaining three quarters should be distributed among the Shareholders, so that the survivors might even reap benefit from this Humane Design. When 380 of these Shareholders had died, the remaining 20 Survivors were to share one half of the Sum among themselves, and the Society was to inherit the remaining 50,000 Guldens, which would ensure it Perpetuity.

From a detailed Survey of all attempted Rescues which the Society published in 1793 it appears that the number of the Attempts which had been brought to a successful Conclusion during the last 25 years amounted to a total of 990. During the last 19 years the ratio of successful to unsuccessful Attempts was as 1 to 3. During the last 9 years the successful Attempts were 297, the unsuccessful 247. Among those rescued, some had been immersed in water for nearly an Hour.

However, this Society worked not only in the Netherlands, but also influenced Foreign Nations by arousing a desire for Emulation. Soon did the Lover of Mankind see similar measures being furthered in Germany, France, England, and Italy, in North America, the East Indies and, indeed, even in Algeria. Yet, in particular, did *Hamburg* distinguish itself. As early as 1762 the Authorities of this Free City formulated a Plan for the rescue of such unfortunate Drowning People, and they intended to offer Rewards; but the people still adhered to the Prejudice that it was degrading to touch those who had died an Unnatural Death; hence such Measures could not be given Legal Force at that time. The only thing which was done was that the Authorities in the year 1765 (1st April and 26th July) issued orders to the Garrison to the effect that the soldiers on duty should as soon as pos-

sible come to the rescue of anybody who had fallen into the water; that admittance to the guard rooms was not to be refused to such Victims as long as there was the slightest Hope left of Recovery; and that also in that place all possible Diligence should be used for their Salvation. Such occurrences should without delay be reported to the Authorities, so that the City Surgeon could be summoned at once.

The successful endeavours in the Netherlands now had the desirable effect that *Die Gesellschaft zur Beförderung der Künste und nützlichen Gewerbe in Hamburg* was aroused to counteract with all possible force this afore-said Prejudice. In the year 1768, this Society distributed Instructions as to the most suitable Measures for the rescue of Drowned Persons and the methods by which these could be applied. Several machines for the administration of tobacco Clysters were distributed to Barber's Shops and other suitable Places. Moreover, the Society offered a reward of 20 Rd. for each Person who was saved. This, in particular, made the people adopt a sympathetic view to the furtherance of this important Cause. Now the Authorities believed that the time was opportune to issue a Mandate in which everybody was encouraged and called upon to help to recover the Drowned from the water as soon as possible; to use the Measures suggested by the Society; and to call in the nearest Surgeon, whoever he might be. For this, the Authorities offered a reward of 50 Mr. Cour. or a Commemoration Medal of equal value. The City Physician and the Officers of Law were instructed not have any Drowned Person carried to the Public Institution intended for such persons until all the Life-saving Measures had been put to the trial. The Garrison was also instructed

to assist in the transport of such Victims, and the directions of the Society were publicly posted both in and around the City.

Whether it was to be blamed on the old deeply rooted Prejudice, or lack of Confidence in the Measures suggested, or lack of Skill in their application, nevertheless, nothing of Importance was achieved, and the Society saw for a long time its undaunted Endeavours rewarded with only scant Success.

In the year 1776, an essential step was taken for the further improvement of this Humane Work; in that year the Mandate of 1769 was renewed and extended with the special view of creating greater Willingness to receive the Victims and to eradicate the still prevailing Prejudice that those who lent their houses for that Purpose would be put to Expense and Embarrassment.

In the year 1785, the orders to the Garrison were again enjoined, and likewise in the year 1787 the Mandate of 1776. In the year 1790 the Instructions to the Garrison were renewed, and further Instructions as to the manner in which the Victims could be succoured were issued in 1790. Finally, in 1792, a Mandate was issued in order to prevent ice-skating on the River Alster from starting at too early a date. Up to the year 1789, the supervision of the Life-saving Measures was entrusted solely to the Treasurer of the Society; then the Society elected its own Officers for these measures, which had the fortunate effect that Doctor SEIP in the years 1790 and 1791 and Doctor SCHÜTT in the year 1792 took an active part in the affairs of the Society. Therefore it was principally these years which were the most fruitful in appropriate Measures and Improvements.

Before we conclude this account of the Life-saving Measures in Hamburg, which redounds so greatly to the credit of the Inhabitants of that City, we consider it our Duty to annex a table of the Success with which the Endeavours of the Society have been crowned during recent years, from which we hope that the Utility of these Measures will also be evident to our own Countrymen.

The number of rewards given for attempted rescues.

Year	Successful	Unsuccessful	Total sum
1790.....	8	4	12
1791.....	17	9	26
1792.....	19	8	27
1793.....	31	19	50
	75	40	115

Most remarkable is it that the number of Rescued Persons has increased as the Life-saving Measures (vide infra) have gradually approached to Perfection. For the 115 attempted Rescues mentioned above the rewards given are as follows:—

a) Paid by the Authorities of the City.....	544 Rd.
b) Paid by the Society.....	264 “
Total...	808 Rd.

Thus, each of the 75 Rescued Persons mentioned above has cost 10 Rd. 4 Mk. 10 Sk., apart from the total costs which have been spent on the Life-saving Measures. We find that this price must be said to be

very low compared with the real Worth of the life of a Man, a Fellow Citizen. When an Opportunity is offered to any one with Good Will who is prepared to assist the Victims among his Brethren, it is both a noble and great Encouragement to learn that the number of Successful Attempts in recent years compared to the Unsuccessful, according to the accompanying table, is as 2 to 1.

As early as the year 1770, L'Académie des Sciences in *Paris* had, by Royal Command, issued an Edict in which the most suitable means for the rescue of Drowned Persons were recommended. But as this, according to reports, contributed little to the fulfilment of the Good Intentions given therein, the example from Holland more seriously attracted the Attention of the French. As a consequence of this, the Royal Lifeguards were commanded to assist Drowning Persons; to carry on their person the Decrees issued on that occasion, giving complete instructions for the treatment of the Drowning Persons; and to have a chest at hand provided at the Public Expense, containing the requisite Life-saving Devices, so that those on duty could at once go to the Place where such an Accident had occurred. A Reward was offered to the one who first reported that a Human Being had fallen into the water, and to the Soldiers who used the Life-saving Devices; and the Government promised to recompense all Costs incurred. In Paris, the Custom prevailed, which is worthy of imitation, of issuing a detailed Annual Report on the promotion of the measures and on what had been done in order to save Drowning Persons*). The most important

*) Detail des succes de L'Etablissement que la ville de Paris a fait, en faveur des personnes noyées.

purpose of this was to bring to light the Benefit which had been derived from these Measures. Up to the year 1776, three fourths of the Drowned had been rescued and revived.

The English have also shown that they appreciate the worth of the lives of their Fellow Beings. In *London*, the *Humane Society*, which had been founded in the year 1776 following the example of the Dutch, had made considerable Progress towards Perfection in this Cause which is so very important to the General Public. This Society had been fortunate enough to take Public Measures which were so efficacious that even the citizens of Hamburg, whose measures are so excellent, admitted that they were decidedly superior in all respects to theirs. In the year 1794, it was reported by the Society that these Measures had been used in the attempted rescue of little fewer than 3000 Victims. Of these attempts, two thirds had been brought to a successful Conclusion, from which it appears that the Society within a period of 18 years had saved the lives of two thousand People in London alone. Naturally enough, the news soon spread to *Scotland*, where the Authorities without delay gave this subject the Attention which it so highly deserves. To the famous WILLIAM CULLEN belongs the Credit of having set forth its Importance in its true and proper Light. He wrote to LORD CATHCART carefully describing the best Life-saving Measures, and also tried to urge on him how necessary it was that the Authorities lend assistance to the Promotion of this Cause*). This letter had the desired effect. On the command of the Public Authority, the requisite implements for

*) A Letter to Lord Cathcart concerning the Recovery of Persons drowned and seemingly dead. London 1776.

the rescue of Drowning People were provided at the Public Expense in *Scotland*. A double set of these was established in each parish. Rewards were offered to those who had brought back a Drowned Person to life, and also for attempts which proved unsuccessful. CULLEN's Life-saving Instructions were publicly announced, printed and distributed in the Towns and in the Country Districts.

But this was not all. That Humane Society has spared neither Pains nor Costs in the hope that, by its example, it might arouse Gentle and Sympathetic Feelings in the human breast. To sundry places both within Europe and outside it, to the most enlightened University Faculties, it has, at its own expense, sent the requisite Instructions as to how similar charitable Societies could be established, and as to the apparatus and Plans of Treatment it held to be the most fitting for the recovery of Drowned Persons. Vienna, Lisbon, Dublin, Philadelphia, Pennsylvania, Algeria and Copenhagen amongst others have each received such Advice from London, and to the credit of Humanity be it said that the Seed which has thereby been sown in the human breast in many places has born Beneficial Fruit. For fear of being too circumstantial we pass over what has been done for this purpose in *Vienna, Saxony, Venice, Milan, Padua, the East Indies, America* and sundry other places. But we must add the curious Item that the inhabitants of *Algeria*, these rough, unenlightened, barbaric people—whose Mul-lah, Ismael, with his own hand killed 80 of his kinsmen—these people, who generally hold Human Life so cheap and are so indifferent to Human Misery, not only were touched by the news of the Progress and great Usefulness of the English Life-saving Measures,

but even more, they at once established similar Public Measures, which now afford hope of Rescue, even for *Danish* citizens, who might be so unlucky as to fall into the water in Algeria.

Less safe, however, is the Danish citizen in the bosom of his own fatherland, whose sad lot it was, for a long time, to be less forward both in the Sciences and in Institutions for promoting the Public Weal. His country has unfortunately as yet done very little for the recovery of Fellow Citizens whose lives by accident become a Prey to the Water. Our famous and venerated Archiater, Professor P. G. HENSLER, was the first amongst us to draw the Government's attention to the care which the State owes to such unfortunate Persons. In a printed treatise, which he published in German in 1770*), he described the Life-saving Measures which were at that time considered to be the best, so clearly and so nobly that this treatise was everywhere considered to be of the most Sterling Value. As a result, the Danish Government issued a Command of the 21st of August of the same year to the effect that every Parson, parish Executive Officer, Country Lord Lieutenant and Bailiff in the Counties of Copenhagen, Fridriksborg, Kronborg and Hirschholm, as well as in the District of Aads, the Kingdom of Norway, and the Country of Bornholm should, at the expense of the King, be provided with a translation of this treatise**), which should always be given to the succeeding occupant of the Office for the con-

*) Anzeige der Hauptsächlichsten Rettungsmittel. Altona.

**) This translation is made by Dr. GARBOE, Titular Councillor to the Court, Practising Physician in Copenhagen.

venience of all and sundry. This Command was promulgated by a Proclamation of the 25th of September of the same year from the Exchequer.

Somewhat later, on the 22nd of April 1772, the King issued an Ordinance for the *Duchies*, in which it was commanded that every Man, without exception, should with the greatest Diligence help such Victims, by drawing them out of the water without delay, carrying them into one of the nearest houses and there take all possible pains to bring them back to life; for which end an abstract of HENSLER's treatise was appended. It was also commanded that Surgeons, Barbers, Inn and Tavern Keepers, Bailiffs and Schoolmasters, in particular, in the country should benevolently lend their houses for such a dutiful and Christian purpose, and that they should at once report such Occurrences to the local magistrates. Those present should with the greatest possible Dispatch fetch a Physician or a Surgeon, or if none such was to be found in the neighbourhood, then it was the Midwife or Schoolmaster of the district, whose duty it now became to procure the necessary Life-saving Devices. In all places where there was a Garrison, those on duty should always and without delay be helpful, keep order, etc. No Drowned Person must be left to his Fate, no matter how long he had been in the water and lain lifeless, unless the unmistakable signs of putrefaction appeared on his Body. On the other hand, the Government promised to pay a reward of 5 Danish Ducats, or to bestow a Medal of the same value, to any one who could prove, and have it testified by the Authorities, that he had rescued a seemingly Dead Person. In addition, the Government promised to defray the Costs involved from the Poor-

Relief Fund, no matter whether the attempted Rescue had been successful or not.

Finally, the Danish Chancellery issued the following Proclamation through the Police Chamber on the 9th of May of the same year:—

1. "That all Persons, be they Fishermen or others, who of necessity cut a Hole in the Ice, shall be liable under the Penalty of 14 days' imprisonment on a Diet of Bread and Water to erect a Mark in these Places, according to the Instructions of the local Magistrates, and that this shall be supervised by their Representatives; the Royal Generality and Commissary Court has likewise been requested to co-operate for this End by causing Sentries who are posted in the Neighbourhood of the Canals and other Frozen Waters to keep anybody away from the Places which are marked as dangerous.

2. That when Anybody is noticed to have fallen into the Water, then shall the one who first becomes aware of him, with the Aid of anybody who may chance to be there or in the Street, or with the Aid of the nearest Dwellers, at once carry the Drowned Person into one of the nearest houses, where the Dwellers must not refuse to accept him, under the Penalty of 50 Rd. to be paid to the Common Poor-Relief Fund of the Town, following which the said House Dwellers shall without delay send for one of the nearest Surgeons or Physicians, who shall then, be he in the Service of the King or not, without fail present himself and there direct and use the most convenient Means for the Recovery of the Drowned Person; if the Life-saving Measures be successful or give Hope of Success, the Rescued Person shall at once be taken to Friderichs Hospital, to the General Hospital or to "Søe-Quæst-

huset," if he be found within the Bounds of the City or in a Place which is nearer to one of these said Hospitals than to St. Hans Hospital; but if he be found on the Peblinge Lake or elsewhere outside the City, where St. Hans Hospital is the nearest, then he is to be taken to this Hospital, and the Surgeon shall there provide for his Care and Recovery.

3. That if, in the Attempts made, it prove impossible to bring the Drowned Person back to Life, such Occurrence shall be certified in writing by the Surgeon or Surgeons present, and when the Victim's Abode or his nearest Kin are not known, the Occurrence shall be reported to the Bailiff, who shall cause the Victim's Body to be fetched, and take all further Measures necessary.

4. That the Moneys spent on Medicaments, the transport of the Victim to the Hospital or otherwise shall at first be refunded by the Public Funds, and the Occurrence shall be reported to the Chancellery."

This is the most important Measure which has so far been taken by the Government in this Cause which is of so great Public Concern. However, it is reported that Hr. FLINDT, Titular Councillor of State, in the execution of his official Duties as Chief Magistrate has recently made a Proposal for the better treatment of Drowning Persons to the Danish Chancellery; but as we do not know the contents and the proper purpose of this Proposal, we cannot give a detailed report of it; we can only regret that this has also been without Benefical Results.

Consequently, public Life-saving Measures are still lacking everywhere in the Danish States. Not even our Capital of Copenhagen, which is surrounded by water and intersected by so many Canals, has taken

the least measures for the rescue of the many People who, according to the reports of the Gazettes, are found dead in the Water every week. In vain has Hr. TODE time and again, with the Energy which is particular to him, been the Spokesman for these Victims with our Fellow Citizens; in vain did he, together with Hr. MANGOR, many years ago appeal for donations, so that Public Measures could be taken. His Voice was not heeded by the Poor People when he spoke earnestly, and his satire left the Rich unaffected. Despite all his Good Will he achieved so little that the following year he believed that the sole good he could accomplish was only to utter the prayer: "God be merciful to their poor Souls!" Yet a few individual Men have distinguished themselves by offering Rewards of 10 Rd. for the resuscitation of such Asphyxiated Victims; which rewards, however, so we believe, have been given only once. Such inducements are merely of a temporary nature, since they usually cease at the death of those who offered them. Of this nature, we suppose, was also the reward which the Chief Magistrate, according to the report of Hr. TODE, was to pay to the one who took a Drowning Person out of the water. We fear that this encouragement has already ceased, since it does not figure in the accounts rendered by Hr. HOFTVED (in issue No. 107 of *Adresavisen* for this year) among the rewards given to those who on the 4th of December last year rescued a Drowning Child at Hirschholm.

Few and uncertain are thus the encouragements which are so necessary for this End. Much, nay everything! is lacking both for him who desires to rescue his brethren from the water, and for the Doctor who by his Art endeavours to bring him back to

life. Therefore, large Crowds of People so often throng together, with no avail, on the banks of the water in which such a Drowning Person fights against death. In vain does the Victim utter the most heart-rending cries for Help. Because of lack of implements the Spectators usually find that all help is impossible; no-one ventures to place his own life in such evident jeopardy. The consequence is that the Distressed Person sinks lifeless to the bottom and is not rescued until the last Spark of Life has already left his body. For the same reason, even the most worthy Doctor sometimes seems unwilling, reluctant and dismayed at the moment when by his Benevolent Assistance, like the Creator Himself, he might breathe life into his own image. Nevertheless, he is not to be reproached for an Attitude of Indifference to the onerous duties of his Calling. We must imagine his position: to see a dying Fellow Being and to know the Means by which his life might be saved, but, at the same time, at the most crucial moment not to have these Means at his disposal or to be unable to procedure them with Dispatch! Indeed, he, who at the thought of this, or in this situation, does not lose Courage, Zeal and Inclination has no Human Feelings. He is either more or less than a Human Being. Accordingly, these Means ought to be provided at the Public Expense and be available for the Doctor in the vicinity of every Canal and in any place where a Human Being is exposed to the risk of dying in the water. The Private Physician does not always himself own the Apparatus which is required for this purpose, and even if he has this, he cannot always carry it about with him; nor can it be had at the Apothecary's. Is he then, when he is called in haste to an Asphyxiated Person, first to send for

this Apparatus in another part of the City before he can discharge his duty? If so, the precious moments during which there was still a Ray of Hope slip by, and his endeavours are afterwards without the least avail. It is here that we must seek the true reasons why Drowned Persons are so seldom brought back to life in our country; why out of one hundred Victims scarcely one is awakened from the Sleep of Death by the aid of the Physician; and why the Measures so far taken have not given the results desired. When we except one report by Hr. TODE on two successful Recoveries which were achieved by the County Surgeon, Dr. SCHVARZAKKER, the last several years have not seen any authentic Proofs that a Drowned Person has been brought back to life, either by Private Persons or in our Public Hospitals.

*Survey of the Most Beneficial and Most Convenient
Means for the Recovery of Apparently Drowned
Persons*

The principal objectives of all the Noble Measures which have been taken in the most Enlightened Countries in Europe have been:—

a. To bestow on the matter the general interest which has been so notably lacking in the former dark days.

b. To encourage All and Sundry to yield prompt assistance.

c. By examples and commands to remove the obstacles which are caused by prejudice and superstition.

d. To have the Drowning Persons expeditiously and carefully removed from the water and taken by the most convenient means to the nearest and most suitable place.

Finally,

e. To ensure that they are given treatment by the method which was then considered to be the best one known.

We now wish to give a brief survey of each of these items.

a. If Enlightenment among a single Class of the People has ever been of benefit to the Public, then it is undeniably so in this important matter. This is done by pointing out the worth of the individual to the General Public; by showing how easily it is possible that any individual man or anybody who through bonds of Friendship or Kinship is dear to him, may, early or late, suffer this unfortunate fate; by making it clear to everybody that such a Victim is lost not only to himself, but that also the State in him possibly loses an honest, useful Citizen, his Wife a good Husband, his Children a good Father; by arousing the Thought, the sad Thought, that many a time such an important Fellow Citizen could undoubtedly have been rescued if one single Man had felt deeply enough the duty he owes to his Fellow Creatures. For these apparent reasons, this matter attracted public attention, and through this the Doctors, for whom such unfortunate cases were also of exceptional professional interest, were encouraged to investigate with diligence by what means such a apparently lifeless Victim could best be given back to the State and his Friends. As

Medical Art approached perfection, the number of recoveries increased, and the effect of these examples, made publicly known, was so strong that the Governments of most Enlightened Countries considered it a Sacred Duty to provide Public Measures for the recovery of such Victims; patriotic men joined together in order to work for the same honourable Cause; and finally, the less enlightened began to hope that this Cause might possibly be accomplished.

b. Now the opportune time had come when it might be expected that encouragements for the rescue of the Victims would be heard and would be well received by the People. Now every good Citizen felt how great, how noble, how important a deed it was to tear such a Victim away from the Arms of Death and give him back to the Bosom of his Family. The enlightened honest Men in the States who had gained the confidence of the People now solemnly advanced these Views. Lucidly they explained how highly such an act ranks among those Deeds which carry their own rewards, and how much honour it bestows on the Doer. Yet this was not all. The less wealthy part of the Populace—which was also the more numerous—was the very part from which it would be most reasonable to expect Aid. Consequently, it had to be safeguarded against being put to expense when one of its Members with self-sacrifice performed such a noble Deed. It had also to be assured that it could get requisite assistance from helping hands. For these ends, provision was made by the States and by individual Societies; the former by especially enjoining Readiness upon the Guards; the latter by recompensing the Costs incurred. He who was dead to the Voice of Nature and was not aroused by these encouragements was

yet persuaded, by rewards for diligence and by punishments for reluctance. Only for him who unhesitatingly, without payment, did everything within his power was this Reward a tangible token for deserved Honour.

c. However, these encouragements were not sufficient to overcome all hindrances. Deep-rooted Prejudices, which had to be defeated, still prevailed. Goodwill still yielded to superstition and Distrust to the efficiency of Medical Art. As long as the ordinary man had no knowledge that putrefaction in a Drowned Person is the only reliable sign of death; as long as he relied on other erroneous Signs and clung to the mistaken opinion that he who was thus supposed to be dead would remain so for ever, since, according to the proverb, there is no medicinal Herb strong enough to cure Death; as long as this state of affairs prevailed, there was little to be hoped for from the ordinary man for the recovery of Drowned Persons. Moreover, the Multitude perhaps feared to come to the rescue of those who had thus perished, because the law forbade them to touch those who had deliberately taken their own lives, which might possibly be the case with a Victim lying in the water. Besides, the dead bodies of such persons were considered to be degrading and should be received only by the night-man or be taken away by convicts. Thus were even well-intentioned Laws and time-honoured Institutions, obstacles to the furtherance of this Cause. It consequently became the Task of the Legislature to impart suitable qualifications to these laws and to present them with a Philanthropic Spirit for the better information of the People. It rested with the Philanthropists to make clear that the deed of leaving a Drowning Person, when it was

still uncertain that he was dead, was just as indefensible and inhumane as recklessly burying an Asphyxiated Person who might still have been brought back to life. Finally, it became the duty of the Doctors to decide, and to teach the people, how unreliable were the signs of death which had formerly lulled the Multitude into that harmful feeling of surety; to show how little could it be trusted that a Drowned Person was really dead because he was stiff, cold, without any sensation, palpable pulse or breathing, etc.; and by examples to convince the People that Drowned Persons in whom all these signs have been present have yet been brought back to life by the application of suitable Measures.

d. The actual Assistance which according to the situation might be most necessary and most suitable was now the essential Problem awaiting solution.

Nobody doubted that the hope of rescuing a Drowning Person was usually directly related to the Length of Time he had been under water. Here, breathing must necessarily be arrested and it has always been agreed that this is the actual cause of Death by Drowning, however different the Effect of this has been conceived. It thus became a Principal Rule to get the Victim out of the water as swiftly as possible. During this, Care had also to be taken that the body of the Drowned Person was not exposed to any violence, especially as far as the Head, Neck, Chest and Abdomen were concerned, and that as far as possible he was pulled out in an erect position, in such a way that the body was taken out head-first. The recovery of such Persons was always easiest either when it was possible to throw a rope to the Victim, or if a man who was a practised Swimmer was able to reach and

assist him before he sank feebly to the bottom. Therefore it was also useful if, here and there, on Lakes and Canals, boats were kept in readiness, in which others who had no Skill in swimming could hasten to the Victim's aid. It is shown by daily experience that death by drowning is rarer in Places where such Boats are available. If no Life-saving Measures be taken until the Drowned Person has already sunk to the bottom, then is it more difficult to find him and to pull him out of the water without inflicting injury upon his body. In general, the rescuer then makes use of such instruments as happen to be at hand, and, in particular, of the Boat Hook, although this is a very unsuitable and dangerous Implement, since both its hook and its point may easily injure or even kill the person whom it was intended to rescue. Exactly the same applies to the so-called "Drakken" used in Holland. Neither are simple Poles, Oars and the like suited for that purpose. Credit is due to the mechanic, BRASCH, of Hamburg, for his invention of two Instruments which are both simple and appropriate for this purpose. The Society in Hamburg had these Instruments manufactured and introduced their use, which was attended with much success. They consist of a "seeker" and a pair of cathing forceps. The "*Seeker*" (see the copper engraving, Fig. 1) is a rounded wooden Pole, about 16 feet in length, which is provided at one end with a curved Fork made of iron; its Prongs end in a Ball and are placed at such a distance from each other that they can conveniently fasten around a Human Body. By means of this instrument the Drowned Person is carefully sought for, and when it is felt that the body has been found, its

position is also ascertained in order to apply the *Catching Forceps* to the greatest possible advantage.

As shown in Figures 2 and 3, these consist of the following parts: (a) a rounded wooden pole, about 16 feet in length; (b) an iron Pin; (c) an iron Mounting around the upper part of the Pole; this runs into a transverse Pin (d), around which the Arms (e, e) move; (f) a thicker iron Ring, which can be pushed up and down on the iron mounting. From either side of this ring projects an Iron Bar (g), which is movable at (h), (i) and (d); two curved Arms (e, e) are open in the middle; they are mounted on the transverse Pin (d) and run straight out to the sides and are joined to the Iron Bar at (i); (k) is a Rope which is fastened to the ring. When these forceps are lowered into the water, the Iron Ring (f, f) falls by its own weight down to (d), so that the Arms (e, e) by means of the Iron Bars (g, g) move into an open position as shown in Figure 2. When the body of the Drowning Person has been discovered by the "Seeker" and its position in the water has been ascertained, the open catching Forceps are thus lowered along the "Seeker," and when the body has been carefully enclosed by the arms of the forceps, these are tightened by pulling the rope, as illustrated in Figure 3. The rope is then fastened around the Pin (b) lest the forceps should open again. The body is then cautiously pulled to the surface until the rescuer can exert a grip under the arms of the Victim and take him into a Boat or directly ashore*).

*) In Hamburg, such a "Seeker" and Catching Forceps cost from 9 to 10 Rdlr. Made of Brass instead of Iron, they would be more costly, but also be more durable, as this metal does not rust (sic!) so easily.

The Victim is then placed on the Back leaning a little to one side in a Basket made for that purpose, see Fig. 8. This is the length and breadth of an Adult Man, and is curved upwards at one end, so that the head of the Drowned Person can lie a little higher. On either side of the Basket there are four Rings in which carrying Poles can be inserted. In such a Basket, woven of osiers, the Drowned Person may lie quietly, in the most advantageous position and far more safely and comfortably than on the ladder or other implement which is commonly used for that purpose. It is also much easier for two men to carry him in this Basket to the place assigned for his Revival. The water can also trickle away from the Victim through such a Basket, while those carrying him will not become wet. CULLEN has suggested that the carrying should be done in a Cart in which some Straw has been placed. He believes that the jolts during the journey would probably do more good than harm.

These Implements may be used at any time of the year, and in Summer they are fully sufficient, whereas in Winter when the water is covered by Ice, more implements are necessary; for, firstly, it is difficult to come near enough to the Victim and to get a safe Foothold, and, secondly, the Act of Rescue often involves evident danger for those who intend to bring succour, so that they themselves may become Victims of their own Benevolence. In addition, the help must come more swiftly since the cold of the Winter also exerts an adverse effect on the Victim.

When the Ice was so thin that no one dared to come near him who had fallen through, the only Help which was formerly given, consisted in throwing out a

Rope to the end of which a wooden Ball had been tied. But quite apart from the fact that it was always difficult to hit the proper place; that the attempt therefore often had to be repeated, by which precious time was lost; that the Victim seldom had strength enough to grasp the Rope; and that it was difficult to get him on to the Ice and then haul him ashore, he was always, if he were hit by the Ball, in danger of receiving injuries to the head at the very moment when others were working for his Rescue. For these reasons, the Society in Hamburg, which used such Balls as early as 1776, has abandoned them and now employs instead a Life-saving Ladder and Boat.

The *Ladder* is shown in the copper engraving, Fig. 4. It must be made of light wood lest it should weigh too heavily upon the Ice, and be of almost the same length as the "Seeker." To its upper Rung (a) is fastened a long movable Pole (b) with a Knob or Handle at the end; when this Pole is pushed upwards and aligned with the Ladder, it may be used for pushing the ladder so much farther forwards on the thin Ice. On this implement the Rescuer may thus place himself and, with safety, be pushed forwards by a Helper standing ashore or on firm ice towards the person drowning, and extend assistance to him; for even if the Ice breaks under him before he has reached his Goal, he may yet be pulled back in time.

The *Boat*, Figs. 5 and 6, is made for lightness, like an ordinary basket of osiers, and its outside is covered with leather in order to make it water-tight. Its outer length at the bottom is $7\frac{1}{2}$ feet, and its length at the top is 12 feet; its width is 3 feet below and 4 feet above. The upper Gunwale of the boat must be smoothly rounded everywhere, without any sharp

corners or edges, which may become an Obstacle and injure the person who is to be pulled aboard.

The bottom of the Boat is shaped like a Sledge and is provided with two runners with smooth iron rails, Fig. 6 (b, b). Between these, roughly in the middle of the boat, there is a rectangular opening, $3\frac{1}{2}$ feet long and $1\frac{1}{2}$ feet wide (c); from this opening an oblong basket runs up to the level of the upper edge of the Boat; on either side, the upper edge of the Basket is provided with handles by which the Boat can be carried, Fig. 5 (c, c.) The Basket has an inner lining of leather, just like the outside of the Boat. The stem and stern of the Boat are made of wood faced with smooth Iron Plates and provided with a Ring at the upper end, to which a rope may be fastened (a, b). In the stern of the boat is a Chair, made of wickerwork, the back of which slants over the Gunwale, Fig. 5 (d).

A Boat made in this way may easily be carried by one Man on the ice and, if necessary, be steered in the water, without any danger to the rescuer*).

Where the water is covered with thin Ice, and when attempts are made to rescue a Drowned Person, the

*) On the River Danube at Vienna and in several Spanish seaports this Boat has been used successfully, according to the example set by Hamburg. In order to facilitate the Rescue of those who are in danger, D. RAIMARUS has further suggested that the Boat be provided with a catching rope passing across a pulley placed in the Stem. And as it may often happen that it would be good if the Boat could be made fast to the ice, we would consider it useful to place in the bow of the Boat two spikes which could be driven into the ice. Such a Boat with all its accessories costs in Hamburg about 50 Rdlr. and may, if it is preserved well, be serviceable for a number of years.

Boat is placed on the ice and the ladder (Fig. 4) is fastened to the ring in the stern (b) by a long rope, so that it may either be dragged after the Boat or remain on the Shore, so that the Rescuer, if need be, may pull it towards him. A man sits down on the edge of the Basket (c, c) in the stem of the Boat and poles it forward like a Sledge by means of a Boat Hook or a shorter, specially-made Pikestaff.

Where the Ice is so rough that the Boat cannot slide forwards, he steps over into the basket and carries the Boat (see Fig. 5) until the ice again becomes smooth. However, if the ice breaks, he steps back from the basket into the Boat; the water will then rise as high within the basket as it stands outside the Boat and assist the light Boat to maintain a stable and balanced position in the water, and prevent it from capsizing.

When the Boat is floating in the water, in order to progress further, it is necessary to break the Ice in front, and although this does not involve any Hazard, nevertheless it is difficult again to lift the Boat onto the Ice. To do this may require also a greater Length of Time, and, indeed, sometimes the assistance of several Persons, even when the Stem or Stern runs obliquely against the Ice; therefore it is better not to push the Boat farther forwards when it is noticed that the Ice may probaly break. If this be so, the desired aim may be sooner achieved by use of the Ladder in the manner previously explained—the Man who stands on the firm Ice helps the Rescuer by holding fast to the extended pole.

When it is not possible, even by means of the ladder, to approach the Victim, the Rescuer may, according to D. REIMARUS's proposal, use a longer Pole provided with a Cross Bar, to which two or three ropes with

light wooden balls may be fastened, roughly as we have shown in Fig. 7. The choice of these implements can easily be made by every Thinking Person, according to local circumstances*).

When the Drowned Person has successfully been taken into the Boat, he is placed on the Platform or Chair provided for that purpose, in such a manner that the head rests a little higher than the body. If his

- *) An ingenious Device invented by a Sergeant in England by the name of JOHN BULL, by which those who are in danger of being shipwrecked may reach Safety, deserves to be known by Seafarers. He filled a Bomb with lead, which was 8 inches in diameter and weighed 70 pounds. This was provided with a Ring to which he attached a long Rope. This Device was taken on board a Boat which carried a suitable Mortar and rode at anchor about 600 feet from the Beach. After having made the other end of the rope fast to the Boat, arranging everything properly and loading the Mortar with the Bomb, he shot it ashore. It fell about 300 feet from the Beach, 18 inches deep in the Sand. On a Raft made of Barrels and Casks, to which planks had been fastened, was placed a suitable ballast. BULL and another man went out on this Raft and, by means of the Rope, they hauled themselves ashore within a few minutes. He made three tests, which were all successful, for which reason he received a reward of 250 Rdlr. from the Society for the Encouragement of Arts, whose Commissioners had been present at the Experiments. As it is generally easy for Seafarers to have the requisite Implements at hand, and as the Device is simple and would be very useful in many an accident, it is recommended as a serviceable Invention, which might safeguard the lives of many Fellow Citizens at the most dangerous moments when no other help can be expected.

Neckcloth be tied tightly around the neck, it is at once loosened. The Boat is poled ashore as swiftly as possible, and the body is placed on the back in the Basket previously mentioned and carefully carried to the nearest House assigned for that Purpose. When no such Basket is at hand, he is most conveniently carried on the arms of two men, in an half-sitting position with his head erect. The movements must be as even as possible, so that he is not shaken too much. If such be at hand, he is wrapped in Straw or in a Blanket to prevent excessive Coldness during the journey.

The Room in which he is placed should be spacious and airy, yet without a Draught. Windows and Doors should therefore not both be open at the same time, and no curious Onlookers should be admitted, lest the Atmosphere should become filled with harmful fumes from their exhalation and the Vital Air be consumed by their breathing. Small and close Rooms and Ships-Cabins are therefore unsuited for this purpose. In Summer and Mild Weather it would be better to attempt resuscitation in the open Air, or in a Shed, if no more convenient Place be available. On the other hand, in Winter it is necessary to have a Room provided with a Stove, so that it can be moderately and evenly warmed. However, necessity demands that, instead of wasting precious time, a less convenient Place should rather be hastily chosen in which the actual resuscitation measures can be applied without Delay.

When the Victim has been carried to such a place, the nearest Doctor is sent for at once, if this has not already been done, or if any such Doctor has not come without being sent for. In the meantime, some helpers must find a place where he can lie, for which a Table,

a Field Bed, Couch or the like will be sufficient, and put some straw upon it, while others unbutton his Clothing and carefully cut it off without injuring the body or handling it too violently. He is divested of his Clothing and moved to this Bed of Straw; where he is placed a little on one side, with the head raised, and is then wiped carefully with a dry Cloth. If then it be found that the true, infallible Signs of Putrefaction are absent, the actual remedies for resuscitation are applied.

We shall first consider the Changes occurring in the Victim while under the water, where he gradually shades from real Life into seeming or true Death; we shall then later describe the Means, and then give the reasons which either induce the Doctor to use each of these Means or justifies his Conduct when he discards them, although, perhaps, excellent Value may have been attributed to them by Doctors in the past.

When Man, who is destined to live in Atmospheric Air, by an accident falls into the water, his Breathing must needs be stopped. Some of the Air which remains in his Lungs is at once, with convulsive violence, expelled from the chest and rises to the surface of the water in the form of Bubbles. Then he feels an urge to breathe in new Air. He endeavours to do so in vain; but in these Endeavours a small amount of Water is usually drawn into the Lungs. From these, some more Air is expelled, whereupon violent efforts to breathe follow, and this continues with increasing Anxiety for some minutes. Finally, a weak Rattle follows, and respiration is completely arrested. While this is happening, the Victim exerts all his Strength to rescue himself and usually rises one or more times towards the Surface of the Water, until he ultimately sinks feebly

to the Bottom. Left to himself, the Victim remains there until his dead body, by the process of putrefaction, begins to disintegrate; then it becomes lighter than Water and by the General Law of Gravitation is lifted to its Surface.

If such a Person be recovered from the water immediately after his endeavours to rescue himself have ceased, the following observations can be made: The Lips are of a blue shade; the Nose, Cheeks, indeed, the whole Face is pale like the rest of the skin; the Eyes do not protrude, having as yet more or less retained their natural Brightness, but the Pupils are remarkably dilated; the Mouth is filled with foaming Slime; all Feeling and Movements which can be perceived have ceased; yet the right chamber of the Heart may continue to beat—although almost imperceptibly—sometimes for as long as two hours after the Cessation of respiration. The heat of the body is considerably reduced everywhere, and gradually completely disappears, first in the Limbs, lastly around the Heart, at which time the feeble Cardiac Movements previously mentioned finally cease. That the Eyes are occasionally distended with blood; that the Face is swollen; and that the Skin is of a blackish yellow hue are exceptions which are encountered only in Plethoric Persons and those who have lain in the water with their Heads lower than the rest of the body.

If the body of a Person who has died by drowning is opened, it is usually found that the Windpipe and, to some extent, also the Lungs and the Mouth contain some of the liquid in which he has perished, mixed with Foam; however, experiments made on animals have shown that the Quantity of Water present in the lungs is only negligible as compared with the Amount

of Air which is expelled by the Victim during the endeavours to save himself. Often, the Lungs do not exhibit any changes; they are usually somewhat collapsed; on rarer occasions, they are filled with Air; the cavities of the right heart, the Veins which empty into these, the Pulmonary Artery and its branches are distended by dark, almost black Blood, whereas the cavities of the left heart, the Great Arterial Trunk (Aorta) and the Pulmonary Veins, like the vessels on the surface of the body, are most frequently quite empty; the Veins of the Brain usually seems to be somewhat dilated; yet scarcely any extravasated blood is ever present.

This is briefly what has been observed at the investigations which have so far been made on Drowned Persons. From this account it is evident that no important Organ which is vital for the preservation of life necessarily suffers any violent injury, but that the Vital Powers are merely stopped in their function, and that, accordingly, all physical Function cease. In the same way do all the Wheels of the Clock come to a standstill when the Pendulum is stopped.

So far do those versed in natural Science agree; but as to the questions how the Vital Powers cease and what is the immediate Cause of Death, Opinions have until now been divergent.

Many have believed that the Drowned Person died of Apoplexy. This hypothesis was especially based upon the observation that the veins in the brain of the Victim were usually distended by blood, for which reason the brain was believed to be compressed; this was found to be the more likely, as the Cessation of Respiration, which prevents the flow of the blood through the Lungs and the right ventricle of the Heart,

might also, through this, retain the blood in the Veins of the Neck and Brain. This has been proven by DE LAMÜRE and HALLER by their observation of concordant movements of the brain and lungs in the living animal; nor could any other injury be detected in the Brain itself or in any other vital organ. However, it has been proven that there are manifold reasons testifying against this opinion, and that their number is increasing as Knowledge is widened; for, apart from the fact that the Cerebral Veins are often just as distended in persons who have died in their beds and in whom Apoplexy has never been suspected; that it is quite exceptional to find extravasation of blood or serum in a Drowned Person, be it around the Brain or in its cavities; and that the flow of blood to the the Brain through the Arteries of the Neck must be diminished approximately in the same proportion as its flow through the Veins to the Heart is impeded by the cessation of respiration; apart from all these reasons, there are others as well. This Opinion is further weakened by the observation that life in those who pass away by an Apoplectic Stroke generally manifests itself for several hours, whereas the physical functions in a Drowned Person most often stop within a few seconds. Moreover, in a Drowned Person respiration is always suspended and the Pulse is imperceptible, whereas these functions are usually intensified in an attack of Apoplexy. It should also be noted that the apparently Drowned Person often revives without any trace of Paralysis, while few of those whose lives seem to be extinguished by Apoplexy come back to life, and some Paralysis persists in most of these few. More recent experience teaches us that repeated Blood-Letting is harmful in apparently

Drowned Persons, whereas this remedy is in favour with several Doctors in the treatment of apoplexy. Add to this, that the considerable quantities of blood which distend the Cerebral Veins may, in all probability, have been conveyed to these vessels after death, since, as is known, the Arteries, merely by their elasticity, are capable of propelling the still unclotted blood into the Veins even a long time after the Vital Powers have ceased to function. Finally, Experiments which have recently been made on Living Animals seem to deprive the view that Drowned Persons die of Apoplexy of its worth. In these Experiments, (1) ligation of all the large internal and external veins on the neck failed to produce Apoplexy or similar Seizures. Furthermore, (2) in dogs, both the arteries (*Arteriae carotides*) and the veins (*Venae jugulares*) of the neck were ligated, and despite the fact that the Experiment was repeated several times, none of these animals died of Apoplexy; indeed, most of them survived, healthy, and in good spirits, for several weeks afterwards. Only a few seemed to be drowsy for a couple of hours after the operation. Likewise, (3) both Carotid Arteries were ligated, and the Animal was hung up by the neck for half an hour afterwards; within 4 minutes the Animal ceased to make any movements. When it was opened, it was found that the Cerebral Veins were not distended; on the contrary, they contained less blood than normal, so that the Animal could not, consequently, have died from Pressure on the Brain. Strange is it that nevertheless it died just as soon after the strangulation as others whose Carotids had not been ligated. In a similar experiment, (4) a hole was cut into the lower part of the Windpipe; above this artificial opening

was tied a String by which the Dog was hung up round the neck and left for three quarters of an hour. Respiration occurred through the artificial opening, and the circulation of the blood continued constantly. Then the Dog was cut down, and the string was tied below the artificial opening, so that the Air could no longer penetrate into the Lungs; the Animal was again hung up and was found to be lifeless within a few minutes.

For these reasons, and provided that an analogy can be made from experiments on Animals to experiments on Man, it is very probable that the suspended respiration, inasmuch as the blood-flow from the Brain is thereby hindered, does not produce Apoplexy, and that, consequently, those who perish in the water do not die in this manner. However, we do not intend to deny that Apoplexy may occur in Drowned Persons, viz. if the Victim at the time when he falls into the water is drunk, receives a blow on the head, etc. This may obviously also occur after an apparently Drowned Person has been brought back to life.

Others have expressed the view that the direct Cause of Death by Drowning *should be sought in the Lungs*, although, here again, various differing opinions have been advanced. Some contented themselves with considering only the Arrested Respiration without closer investigations into the consequences this entailed for the body. Others imagined, owing to the arrested respiration, the occurrence of an obstruction of the finer endings of the great Pulmonary Artery, following which, they believed, the Lungs would always collapse. They thought that this was the immediate Cause of Death, and, indeed, nothing seemed more

reasonable, considering that, according to the experiments of RUYSCH and BOERHAVE, the injected agent only with difficulty passes from the Pulmonary Artery into the Pulmonary Veins, except when the Lungs are filled with Air. But if this concept be correct, then it would follow that it would never be possible to resuscitate any such Asphyxiated Person, unless the lungs had been inflated beforehand, which is at variance with several reliable observations. Moreover, this View is merely based on the hypothesis advanced by HALLER, viz. that the expansion of the Lungs is the principal purpose of respiration, which is, however, easily disproved by accurate experiments which show that the Lungs of an Adult Person, on expiration, generally contain 109 cubic inches of Air, which, on inspiration, are increased only to 149, so that the difference which breathing produces in the expansion of the Lungs is far too small to be able to cause any appreciable change in their large blood vessels. Finally, the following experiment is incompatible with this hypothesis: (5) A string was tied around the neck of a dog at the moment it had inspired, thus preventing the escape of the Air; hence the Lungs could not collapse; but nevertheless the animal stopped moving within 4 minutes and died, despite the fact that the autopsy revealed no distension by blood of the Cerebral Veins or of the right cavities of the Heart, from which it clearly appears that no obstruction had occurred*).

*) The experiments to which we have hitherto referred were made by an English Physician by the name of COLEMAN and have been publicly defended by him; they have since been repeated by the famous RIT and, finally, accepted by FOTHERGILL in a treatise spon-

Thus, the Concepts which even sagacious investigators had made of this Subject were very tentative and indefinite until only a few years ago. This was also a necessary consequence of the fact that Natural Science, which has here given us so much information, was still then, so to speak, in its Cradle, and had not as yet been applied to the Function of Respiration.

It had been known for a long time, and by the experiments of LOWER**) had been established beyond any Shadow of Doubt that the blood when it passes from the left chamber of the heart into the Great Artery has a bright red colour, and that this colour becomes darker as the blood in the veins again approaches the heart; it had been noticed that this dark red colour is again changed into bright red during the circulation of the blood through the Lungs, but the true cause of this Phenomenon was still unknown. Natural Scientists of earlier ages had admittedly suggested that Air must contain a hidden Vital Medium; but nobody was able to decide what this actually was, or of what it consisted. Only when the constituents of the atmosphere had become better known was it possible to shed light on this matter. By experiments it was now shown that the Vital Air (oxygen gas) was the only Component of the Atmosphere that was able to maintain respiration, and that this in its Gaseous Form was always combined with

sored by the Humane Society in London. Therefore, we cannot doubt the Correctness of these Experiments. Yet, we intend, at an early date, to repeat each of these experiments at the Veterinary College, and then to report, in a treatise, the results hereof to the readers of the Medical and Surgical Library.

**) See his *tract. de corde*, p. 119.

Caloric. It was observed that this part of the Atmosphere disappeared during respiration, and that the expired air, on the other hand, contained more Carbonic Acid, for which reason it gives a precipitate with limewater. Other experiments taught us that the colour of the blood under the influence of Carbonic Acid became darker, whereas Oxygen, both inside and outside the body, imparted to it that brighter colour. From these Experiments it now became evident that a complex Chemical Process occurs in the Lungs during respiration. According to the experiments which have been made on that subject, the following conclusion is the most probable: Part of the inspired Oxygen combines with the blood in the large blood vessels of the Lung, by which its dark, blackish colour becomes bright red. Another part of the Oxygen combines with the Carbonic Acid of that blood which from the right chamber of the heart is carried to the Lungs, and forms, in combination with some Caloric, Carbonic Acid Gas. Finally, a third part of the Oxygen combines with the Hydrogen Gas given off from the blood and thereby produces the Aqueous Vapours expelled during expiration. Part of the Caloric of the decomposed Oxygen Gas disappears together with the Carbonic Acid Gas and the Aqueous Vapours, but the greater part yet remains united with the Oxygen which has combined with the blood. Therefore, the amount of Caloric in the left cavities of the heart and in the Large Artery is greater than in the veins through which the blood is returned to the right auricle of the heart.

By means of this more thorough and reliable knowledge of the Nature and Utility of Respiration, it now became easier to gain a clearer Concept of the Source

of the changes which occur in the Vital Functions in a Drowning Person from the moment he falls into the water until the Vital Powers have completely ceased to function: For when the water prevents the free access of the atmosphere to the Lungs, respiration ceases at once since Oxygen is no longer present. For the same reason the blood of the Lungs retains its dark colour and becomes unable to give off a specific stimulus to the heart. Therefore it stops in its movements, first those of the left chamber and later those of the right one. When the circulation of the blood has stopped, then, as a Consequence, the function of the brain also ceases, and all Feeling in the entire body disappears; then, little by little, the Animal Heat decreases and, together with it, the excitability of the muscles, until, finally, life is irretrievably lost. Such are the natural Consequences of the Suppression of Respiration; such are the Interactions of the Vital Organs.

Oxygen is thus the Medium by whose influence on the body life is maintained, and in the absence of which it necessarily ceases. Even the Chicken in the Egg is killed when free access of the Vital Air through the Shell is prevented. The Foetus, which in its mother's womb does not breathe, perishes for lack of Oxygen when its blood is not oxygenated by that of the Mother. This is the reason, formerly inexplicable, why blood of the Mother and that of the Foetus must necessarily mingle in the Placenta. This organ was formed by Nature, instead of the lungs, to take up Oxygen Gas (sic!), by which, as previously shown, the excitant property and matter for the formation of Animal Heat are imparted to the blood. That the Placenta really has this function is confirmed by the colour of the

blood, which in the vein of the Umbilical Cord is of a far brighter red than that in its Arteries. Therefore the still unborn Foetus dies from suffocation shortly after its Mother and long before putrefaction has appeared in her body or before it can be considered to be a contributory cause of the death of the Foetus. Therefore it dies when it is severed from the afterbirth and does not breathe, in spite of the fact that the *Foramen Ovale* and *Ductus Arteriosus* are open to blood flow; indeed, it has been found that adults in whom the *Foramen Ovale* remained open have been drowned*). Wherever Respiration is imperfect, or the Air which Man breathes is deficient in Oxygen, and the oxygenation of the blood in the lungs accordingly poor, no regular and permanent state of Health can be hoped for. During the first few days of life, the Skin of the new-born child has a yellowish pale or bluish colour, which disappears once Respiration is working properly. The same observation has been made in subjects in whom the greater part of the Pulmonary Arteries have been conjoined. Finally, we could support this thesis by citing the phenomena which are found in Scorbutics, in those who work in Mines, in those who are imprisoned, etc., if we did not fear that we would thus diverge too far from our Purpose. We hope that what we have already stated will be sufficient for the Reader to enable him to adjudge and realise the value of the Means which should be used in the recovery of apparently Drowned Persons.

e. In the Manner in which the Drowned Person perishes under the Water the Physician finds a true

*) This observation has been made, inter alios, by Dr. MUTH, a County Surgeon.

Guide, which best determines the means he must choose and apply in order to resuscitate such Victims.

It is clear that the entire Plan of Treatment must aim at (1) removing all Hindrances to the Vital Functions; starting again, especially, (2) the Respiration and (3) the Circulation of the Blood; and (4) restoring the suppressed Energy of the Nerves.

It will readily be realised that in most cases it is not the work of a moment to promote these several Aims, but that they usually require undaunted Diligence and sustained Patience. The shorter the time the Vital Functions have been at a standstill, the greater is the Hope of a successful Outcome. If it be found that the Eyes of the Victim still have a bright appearance; that the Pupil is not markedly dilated and still, to some extent, reacts to light; that weak Electrical Shocks are still able to produce contractions of the Muscles; and that there is still some remainder of Animal Heat left, these signs, taken together, bear witness that the Vital Powers of the body are not yet quite extinguished, and that, consequently, it is very probable that they may be resuscitated by the proper use of Suitable Means. Yet the Rescuers should not at once despair or infer that all attempts will be in vain in persons where these favourable Signs are absent; for Experience has often taught us that the Victim, by careful treatment, has been brought back to life, even when not a single one of these signs held out hope of a successful outcome.

1. Under the *Hindrances which may counter-act the unimpeded Manifestations of the Vital Functions* must be numbered everything which compresses blood vessels of an appreciable size on the Neck or the Limbs, and everything which impedes the free expansion of the

Chest or obstructs the access of the Air to the Lungs. That is why the Neckcloth of the lifeless Victim, as previously recommended, his Garters, and so on, should at once be loosened; why his Coat or any other Garment fitting tightly around his chest or abdomen should be removed as soon as possible, and why his Nose, Mouth and Throat should, without delay, be cleansed of all the Froth, Slime and Mud with which these parts are generally filled. This latter is done by a Finger around which a Linen Cloth has been wound; it is carefully introduced into the Mouth and turned until the impurities adhere to the Cloth; this is then taken out and rinsed, or replaced by a clean one. This can be done still better by means of a small Rod of Whalebone to one end of which a small piece of Sponge has been attached. The Sponge should first be dipped in water and squeezed, and then applied to the throat as often as necessary. If the Jaws stand immovably against each other, so that there is no room for either the Finger or the Sponge, it is of great importance to wash out the Nostrils in order to provide free access of air through these.

2. *Above all, the Arrested Respiration should be started again.* From the preceding considerations on the great utility of this Vital Function and its close relation to the other organs, the Reader will have understood how important and necessary this measure is. It is also remarkable that those Movements which first manifest themselves in an Asphyxiated Person are always observed either in the Chest, on the Neck or around the Mouth, in short in such parts whose Sympathy with Respiration is known. Sometimes the Vital Powers which are destined to perform this function in the apparently Dead Person are still so active

that Nature alone is able to surmount the Hindrances encountered, or only very slight artificial aid is sufficient for this. Under such circumstances, an Asphyxiated Person, even when left to himself, may thus awoken from his slumber*), or his Respiration needs, so to speak, only a slight Incentive, like the Pendulum of a Clock, in order to set the lifeless Machine in motion and to give its Organs the freedom to enter into their former relation with the Soul. Therefore, even means which otherwise do not promise any appreciable Aid have sometimes saved apparently Dead Persons. This has been sufficiently taught and confirmed by Experience; but it does not follow that such Means are always enough; on the contrary, it is always one's Duty to employ the best and most powerful available. For this purpose the following Measures may be taken:—

a. Compression of the Chest

As already shown, some foul air (Nitrogen and Carbonic Acid Gas) remains in the lungs of the Drowned Person. If the Chest of such a person be grasped with both hands, and the Breastbone is vigorously pressed back against the spine, some of this

*) This Truth, substantiated by reliable experiments, cannot be brought too strongly to the notice of the practising Physician. Suppose that a drowned Fellow Citizen awoke either spontaneously or by being moved in the Coffin after the Physician had definitely proclaimed his certain Death. Woe unto him, especially if he had not done Everything in his Power! Self-reproach, Disgrace and Deserved Contempt would follow him even unto the Grave.

Air, together with the water which has entered through the windpipe, will be expelled; on the other hand, as soon as the pressure ceases, the Chest is again expanded by the action of the elastic cartilages of the Ribs, and the pure atmosphere is then allowed to enter in place of the expelled Air. By this artificial compression, which invariably—even in an actually dead body—results in the expansion of the Chest, the Lungs are set in motion, by which the Air entrapped in the Chest is gradually expelled and renewed, so that oxygenation may again occur. So far this simple treatment answers the purpose. In Children, whose ribs have longer cartilages permitting freer movements of the Chest, this treatment is more efficacious, because a greater amount of air is exchanged on each compression. However, it may be justly objected against this means that the resultant respiration is only weak; that the Lungs are not expanded so much as in the Natural State; and that therefore, although it is oxygenated, the blood does not have sufficient freedom to flow through the Lungs. Accordingly, Compression of the Chest should only be used at first, until more suitable Means are available.

b. Insufflation of Air into the Lungs

This has been done in various ways. As long as Physicians thought that obstruction of the Pulmonary Blood Vessels was the actual Cause of Death by Drowning, they gave attention only to the mechanical act of respiration. Their endeavours therefore were especially directed to imitating the natural movements of the Lungs, while they did not take much account of

what sort of gas was used for that purpose. In general, they gave the advice that a Healthy Person, who had strong Lungs, should take a deep Breath, press his mouth against the lips of the Drowned Person, and then forcefully blow his breath into the Lungs of the Victim. During this insufflation, the Nostrils of the Asphyxiated Person were squeezed tightly together, and, according to MONRO's directions, the cartilaginous rings of the windpipe (*Cartilago Cricoidea*) were pressed back against the Neckbones in order to close the gullet (*Oesophagus*), so that the insufflated Air could not escape through the Nose or slip into the Stomach. A little time after the lungs had been filled in this way, the Chest was rubbed and compressed with the palm of the hand, from the pit of the stomach upwards, in order to drive out the insufflated air again. Thus, normal respiration was imitated by repeated insufflation and exsufflation.

Experience has taught that this means has often produced the most evident effect. As is known, *Vesalius*, a famous Anatomist of the 16th century, was on the point of losing his life, because he dissected a Deceased Man so early that his heart began to beat again when *Vesalius* blew Air into his Lungs. Many are the still-born Children who have also been resuscitated by this means; indeed, used alone, it has sometimes been sufficient to save the lives of Drowned Persons. Thus, to cite an example, a Surgeon in Nordheim resuscitated a Boy of 12 years, although he had been under water for one quarter of an hour and did not show the slightest signs of life*). Nor can it be denied that the Air that man has inspired still possesses

*) Sammlung der auserlesenen und neuesten Abhandlungen für Wundärzte, 1778.

an Animating Power. Some Oxygen invariably remains unconsumed when a Healthy Person takes a deep breath and at once expels the air again. If this Air be collected in a bag and is again drawn into the Lungs, it will be noticed that it does not become choking until it has been in the lungs either repeatedly or for a long time, through which it has been completely deprived of its Oxygen. This is the foundation on which the Physician establishes his confidence in this means.

But as the insufflation of Air by mouth is a very Toilsome and Loathsome Act, and since accordingly an otherwise laudable delicacy of feeling usually prohibits both the Physician and other People of Propriety from using this method, especially in adults or People of advanced years who have been drowned, it is of only little use. So far, we have heard of only few examples where well-known men have overcome the unpleasant feeling associated with this act and in Honourable Enthusiasm used their own mouths for that purpose.

This method is admittedly less disgusting when one blows through a Pipe-stem or another small Tube which is inserted into the Nostrils or into the Mouth. But as the Air is only slowly forced through such a Tube, the Helper will accordingly be obliged to hold his breath somewhat longer before he can let it go; in the meantime, the inspired atmosphere is with greater certainty changed into Nitrogen and, as such, does more harm than good. Where no more convenient implements are at hand, it is therefore wise to use a Tube for this insufflation having a greater width, for which the Sheath of a Dirk, when the tip of the closed end has been cut off, may be suitable. In experiments

on dead bodies, MONRO has shown that the Air most readily forces its way into the Lungs when it is blown through the Nose. Others have expressed the view that the efficacy of the insufflation is increased by impregnating the breath with Tobacco Smoke or with the volatile principle of aromatic plants.

It is a far better means to bring *Pure Atmosphere*, which has not been fouled by other people's breathing, into the lungs of the Drowned Persons. The Reason for this appears clearly from the nature of respiration (p. 38) and has been sufficiently confirmed by the most accurate Experiments. Of these, we wish to cite only one: JOHN HUNTER had a pair of Bellows made which were so constructed that one could blow pure air into the lungs, whilst the other sucked it out again. The nozzles of these Bellows were inserted into the windpipe of a Dog, and its life was maintained by alternate movements. In the meantime, he exposed the Heart and Lungs by raising the breastbone, but nevertheless the Heart continued to beat as before, only somewhat more rapidly. Then he stopped moving the Bellows, after which the heart-beat gradually became weaker and finally came to a standstill. But when he again inflated Pure Air and maintained artificial respiration, the heart-beats again became just as strong and rapid as they had previously been. He repeated this experiment on the same animal 10 to 12 times, sometimes leaving the Bellows at rest for even as long as 5 to 10 minutes, and always noted that the Heart swelled markedly, and that the blood in its left cavities became just as black as it had been before it had passed through the Lungs. On the other hand, it assumed a bright red colour as long as he inflated

the Atmosphere*). The more the insufflation of pure Air into the lungs thus promises for the recovery of apparently Drowned Persons, the more carefully should the Physician always use this means. If need be, the Objective may be attained by means of an ordinary Bellows, to the blast pipe of which is affixed a flexible Tube, about 2 feet long, ending in a conical wooden Nozzle, the thickness of which corresponds to the width of the Nostril; or this piece of wood may be given a forked shape adapted to the structure of both Nostrils. The use of this instrument is so simple that it does not require any detailed description. The wooden nozzle is inserted into the Mouth, or if this be impossible (p. 42), into the Nose; the Bellows are kept at a suitable distance, most conveniently above the head of the Victim, and are moved in the usual way, so that the Atmosphere is collected and puffed into his Lungs. During the insufflation, Care should be taken that the Air does not escape into the Stomach or out through the Mouth or Nose (p. 45). A few seconds after the Lungs have been filled, the Chest is compressed (p. 44), and fresh atmosphere is again inflated. This is continued alternately until spontaneous respiration is started again, or until all Hope of Recovery has vanished. The insufflation must always be performed with due Caution lest more air should be driven in at one time than the Lungs can receive without being injured. The proper amount is determined by comparing the volume of the Bellows with the portion of Air (p. 36) which Man breathes each time in a normal state of health, and by closely watching the movements of the Chest during the opera-

*) Proposals for the Recovery of People Apparently Drowned, by JOHN HUNTER, London 1776.

tion. In this way, the Water and Nitrogen Gas which are enclosed in the lungs of the Victim are gradually expelled, and the atmosphere, which contains Vital Air, can then, by the effect of Oxygen and Caloric on the blood, vigorously contribute to starting the heart-beat again.

Should the objective not be attained after the insufflation has been continued for a long time, it may be helpful to mix Air with the vapour of a volatile Alkaline Salt, which may be done by holding a cup with Spirits of Hartshorn or the like, below the valve of the Bellows. Thereby the atmosphere assumes a stimulant property, which enhances its Animating Power, especially if it be administered through the Nose, whose lining is intimately connected with the respiratory muscles.

In experiments which he made on animals, the famous FOTHERGILL*) has recently strengthened the assumption of HUNTER and other Learned Men about the excellent utility of *unmixed Vital Air* as a means of animation for apparently Drowned Persons. It is, indeed, an incontestable Truth that the power of the Atmosphere to maintain respiration is exclusively due to its having this gas as a constituent element. Does not this directly lead to the conclusion that Vital Air must possess the animating property of the Atmosphere to a still higher degree? Much is so certain that many enlightened Men of the present time have turned their attention to this means, and both the Humane Society in London and, particularly, the Citizens of Hamburg have already taken the requisite measures, by direct experiments on lifeless subjects, to reveal its true Worth and Utility.

*) Hints on Animation, London 1783, pp. 17-89.

The Vital Air is best applied for this use by means of the double bellows which are said to have been invented by GORCY, a doctor at the Military Hospital in Neubrejsach, and improved by Professor ROULAND in Paris*). As shown in Figure 9 of the copper engraving, this instrument actually consists of two Bellows, which are joined by a Common Middle Board (a), but whose separate air chambers are not connected with each other. In the outer board of each Bellows a hole is cut, as is customary, which is provided with suitable Valves (B, b). In one af these Holes (b) there is a female Screw, into which the Tube (c, c), which is provided with a Tap (d) and attached to the Bag (e), can be screwed. The cylindrical part of the Bellows, through which the air is usually discharged, is here encased in a rectangular Copper Box (f). In this box there are two additional valves for the outlet pipes. The Lid (g) of this box looks almost like a funnel; when it is screwed on, a leather ring is placed in between. From the lid runs a flexible Tube (h) made of a coiled metal wire, which is covered by rubber silk. To the end of this tube is

*) This can be read in Grens Journal der Physik, vol. 1, No. 1, Leipzig 1790, and in Verhandlungen und Schriften der Hamburgschen Gesellschaft, vol. 3, 1792. We cannot determine whether this Statement is correct, but we consider it our Duty to contradict that Herr HOFERAT BOECKMANN, of Carlsruhe, was the first, as stated in the latter publications, to have publicly described the arrangement of the double Bellows. It was described fairly accurately, and warmly recommended, as early as the year 1776 by JOHN HUNTER in his previously mentioned *Proposals for the Recovery of People Apparently Drowned*.

attached another small Tube of Ivory (i), the tip of which is rounded. In all other respects, the valves are made as in newer air pumps; they correspond to each other in the two Bellows, but are placed in the reverse order. Thus, if both Bellows are pulled up at the same time, the two Valves open inwards; one of these is situated on the side board of one Bellows, whereas the other is inside the copper box in front of the aperture of the outlet pipe of the other Bellows. Because of this arrangement, air can consequently be sucked into both Bellows at the same time by pulling the outer boards from the middle board at once, and by compressing both Bellows, air can be discharged through the other two Valves, which open outwards. Below the valves in the copper box the two outlet pipes converge into a common Main Pipe, because the air current, according to the arrangement described, passes alternately only either to or from, although both Bellows are compressed at the same time. When this instrument is to be used, the Bag (e) is filled with Vital Air; the Tap (d) is turned off; the Metal Tube (c, c) is screwed on to the Bellows and the end of the flexible Tube (i) is inserted into the Mouth or Nostril of the Victim. The Tap (d) is then turned on, and the resuscitation commenced, observing the Precautions previously described (pp. 45 and 48). By the first movement of the Bellows, one of these sucks a portion of the Nitrogen Gas through the flexible Tube (h) out of the Lungs, whilst the other is filled with Vital Air from the Bag (e). When the Bellows are compressed, Vital Air is blown into the lungs through the flexible tube, whereas the nitrogen gas which has been sucked into the bellows is discharged through the Side Valve (B) into the atmosphere. This can be continued until

the bag is empty. The reader will easily realise how extremely well this instrument is adapted to its purpose. In addition to the principal Advantage, which consists in the possibility of insufflating Vital Air, both the choking Nitrogen Gas as well as the Vital Air which by its stay in the lungs has become foul can be drawn forth without the necessity of frequently compressing the chest; nor need it be feared that the lungs become excessively expanded by the inflated air, because one Bellows, when both are of equal size, sucks in just as much air as the other discharges. This instrument may therefore also be used with great advantage either when Vital Air is not at hand, or when it is desired to insufflate pure Atmosphere.

In the methods of insufflation of the lungs of Drowned Persons so far described some Hindrances may occasionally be encountered which prevent the Physician from continuing his endeavours. The throat and the upper part of the windpipe of the Victim are not infrequently filled with Small Stones, Mud or other similar Objects. The Glottis may be convulsively contracted, or the Epiglottis may be pressed back. The Physician will suspect the presence of one of these hindrances when the air during the insufflation does not pass into the Lungs and, consequently, the Chest does not expand. If the lower jaw of the Victim can be forced downwards sufficiently, so that the Pharynx becomes clearly visible, it can usually be discovered which of these possibilities is true. The impurities may be removed as previously described (p. 42); attempts may be made to lift the retracted Epiglottis by depressing the tongue and pulling it forwards in the mouth.

Should these manipulations be insufficient, two

other means are known by which it is possible to make the Lungs fill with Air.

One consists in the introduction of a curved Tube, similar to a male catheter, into the windpipe. The Doctor who is to perform this operation places himself on the right side of the Victim, puts his left forefinger into the right corner of the mouth along the lower row of teeth until the tip of the finger passes behind the Epiglottis. Then he takes the catheter in his right hand, passes it along the left forefinger across the glottis and turns it carefully down into the windpipe; then either a Syringe or, still better, a Bellows is screwed on to the catheter, and air is inflated in the manner previously described. This procedure, which is not difficult to perform, has thus been proposed by Professor MONRO*) and seems to be fully adequate when the sole purpose is to inflate air into the Lungs; it may also be used with all Drowned Persons whose mouth is not convulsively closed. Therefore has this method met with the approval of several famous Physicians, who have even found that it was superior to Tracheotomy, but nevertheless it has not anywhere, as far as we know, been accepted for common use.

The second means is *Tracheotomy*. This operation consists in making an incision into the Windpipe on the anterior aspect of the Neck, through which air can be inflated into the Lungs. It should be done only by a Doctor, and it is described in all Textbooks of Surgery. It is the only remedy which can be applied when the Jaws of the Victim are firmly locked together, and when air cannot be forced through the nose into the lungs. For the reassurance of the Common People we

*) See CULLEN's Letter to LORD CATHCART.

may add that Tracheotomy is far less dangerous than was previously believed.

c. Blood Letting

The idea of the prevention of the flow of blood through the lungs and its collection in individual organs (p. 32) aroused an exceptional amount of Confidence in this remedy in the Members of the Medical Profession. Nothing seemed to them to be more reasonable than that Blood Letting, which could reduce the volume of the blood, would facilitate both the function of the Vital Organs and their interaction on each other. Accordingly, this operation was formerly considered to be a Remedy of great importance, so that even Men of Discernment unhesitatingly advised the tapping of at least a Pint of Blood from any Drowned Person. Nor can it be denied that this bold Treatment sometimes seems to have been used with advantage. The Year Books contain comments from which it can be seen that apparently Drowned Persons have escaped Death, although they were bled repeatedly in their lifeless condition. In all probability, the same has happened as in so many other instances, viz. that Salutary Nature has successfully overcome both the Affliction itself and the Remedy which the Doctor used against it.

It is realised that by bleeding a lifeless Drowned Person it is not possible to remove the obstacle to the blood flow through the Lungs or to re-start the Oxygenation; only from respiration can this effect be expected. The Lungs may be regarded as a pair of natural Bellows which during breathing are *passively* related to the respiratory muscles. Admittedly there-

fore, the blood which collects in the *Pulmonary Artery* can make the breathing short, rapid and laboured; but that it should be able to put up an insurmountable obstacle to these muscles and thereby completely prevent Respiration is not reasonable and has not been proven. Moreover, Man has a greater respiratory strength than he uses, as long as no morbid conditions are present; the Lungs can easily be inflated, be their blood vessels ever so much filled with blood; neither does he who suffers from an acute Pneumonia die a sudden Death, etc. It is therefore incredible that the collection of the blood or the increased Weight of the Lungs caused thereby should stop respiration in a Drowning Person! On the other hand, it is very likely that the cause of this should be sought in the Diaphragm and other related Muscles, i.e. in the suppressed or impaired Power of these Agents. Thus, when Blood Letting cannot promote the flow of blood through the lungs, how should those muscles by this means be stimulated to cause the first inspiration? Or is there any other way in which Blood Letting may possibly exert an immediate influence on the arrested breathing?

Just as little is Blood Letting able to arouse the dormant Vital Powers by its effect on the Heart. The agents which towards the end of life propel the blood through the large blood vessels cannot possibly surpass in strength the still active heart. It can therefore hardly be feared either that the right chambers of this Organ should receive more blood than they can hold without harm, or that their expansion should interfere with resuscitation. Furthermore, the Heart should be filled if it is to propel the blood forcibly through the lungs.

For that purpose Blood Letting is thus not so necessary for the recovery of a apparently Drowned Person as has formerly been believed. But this is not all: It may be added that the quantity of blood which the Physician recklessly ventures to tap from a Lifeless Person is unable to bring about an appreciable reduction in the collection in and around the heart, partly because the blood from it would then necessarily have to flow in the reverse Direction through the opened vein, which is at variance with the normal function of this vascular system, and partly because that previously mentioned Power (p. 34) will soon refill the heart with blood until this organ by its resistance again restores the equilibrium which the Blood Letting for a short while had disturbed.

Finally, the condition of the *Brain* of the Victim does not seem to require Blood Letting. We have already shown that these Victims do not die from Apoplexy (p. 33), and that the congestion of blood within the head is not the cause of the cessation of that Vital Function (p. 37) which produces death. As is known, Respiration continues even when the brain is greatly incommoded by pressure. Those who suffer from Apoplexy, or have Water, extravasated Blood or Tumours around the Brain, continue to breathe, even when they are unconscious. The Brain has been found to be hardened in Adult Animals; even nearly full-term human foetuses with no brain have been encountered; and the chicken's heart beats before any other organs can be detected. In short, respiration, whose function depends on the excitability, is not strictly subordinated to the Brain, and even less so is the Heart. Why should it not then be possible to revive a Drowned Person and re-activate his Heart

and Lungs, even though his Brain be congested with blood?

Moreover, Blood Letting is generally considered to be a *weakening* remedy, which instead of reviving and increasing the functions of the Heart and Brain may easily smother and quench the last weak Spark of Life which may still glimmer in the Victim. For this reason it is undeniably the most untrustworthy of all Life-saving Measures, and it should never be used indiscriminately without being expressly prescribed by an Enlightened Physician. As early as the year 1781, the English most seriously warned against its common use*). The Citizens of Hamburg listed Blood Letting as the first amongst all Hazardous Measures which still have the confidence of the Common People; they have publicly declared "that it is helpful only in extremely rare cases, and that it is hardly ever necessary, but in most cases harmful, nay, even indeed, fatal**)." Why should not we then, in accordance with our Conviction, endorse this judgement? We believe that even the Physician cannot ever be too Cautious and Attentive when he has recourse to this remedy, especially if the blood circulation be imperceptible. Should it ever promise any benefit, its use should certainly be restricted to such similar Circumstances as those to which we have briefly referred above (p. 35***).

*) Transactions of the Royal Humane Society, vol. 1, p. 105.

**) Verhand. und Schrift. der Hamb. Gesellschaft 1795, vol. 3, p. 402.

***) We wonder if our famous Hr. HENSLER, since writing the previously mentioned treatise in 1770, has not changed his opinion on Blood Letting as a life-saving measure for Drowned Persons? If so, would it

On the other hand, it is quite a different matter if the Victim after he has been brought back to consciousness falls ill from another Malady; the question of the use of Blood Letting should then be decided by the nature of that Malady.

3. Blood Circulation Should Be Stimulated

Actually, all the endeavours on the part of the Physician aim at achieving this Objective. It was this aim that he particularly had in mind by starting the respiration again (p. 44), and it is also this Objective which mainly induces him to apply the Remedies mentioned below. Here we consider only those which have an almost direct influence on the blood circulation; in the following section we shall make mention of those whose effect occurs more indirectly through the Nerves. If this Vital Function is to take place with the requisite freedom, the blood must not only be constantly oxygenated (p. 38) and be unobstructed in its

not be desirable, or even his duty, to make this publicly known in order to warn and advise all those Danish Citizens who now have his book at hand, according to the Royal Command, and who, when occasions arise, follow its Instructions to the letter? Is it not due to his Authority that many Danish Physicians still have a far too unlimited confidence in this Remedy, and that, in our Country, hardly any Drowned Person, of whose possible recovery there was the slightest hope, is buried—here nobody is saved!—until without much hesitation Blood Letting has been carried out one or more times? Is it not due to his treatise that Blood Letting on the order of a Responsible Person is sometimes performed on the lifeless Drowned Person?

passage through the Lungs, but it must also be fluid—and the Heart and Blood Vessels must possess the minimum amount of force which is required to make it circulate. Next to the cessation of circulation, the most important contributory cause of the Clotting of the Blood in the blood vessels of Lifeless Persons and of its separation into its component parts is lack of free Animal Heat. Of this, one may be convinced by very simple experiments. That the heat is actually reduced in Drowned Persons is not only perceptible, but it may also be ascertained by means of a Thermometer. This is also a necessary consequence of the circumstances which coincide in a Drowned Person, both because so to speak all sources of Animal Heat are choked by the transition into the Lifeless State*), and also because the Water in which this occurs is a far better conductor of Heat than the Air. From this it is also seen how important it is that pure air, from which Caloric may develop and pass into the blood, is brought into the Lungs (p. 38). By this means alone, we may hope to be able to conserve and increase the body temperature. Everything else which the Art of Medicine is able to do is limited to preventing the free Animal Heat from escaping rapidly, and to maintaining Excitability and Sensibility until the body is revived by this important source of heat. From this it may then be deduced why the following measures should be taken as soon as possible:—

*) For these sources, see the wonderful treatise by our Dr. CALLISEN in the Transactions of the Royal Danish Academy of Sciences and Letters (kongl. Videnskabs Selskabs Skrifter), vol. 4, p. 398.

a. Wipe the Victim Dry and Cover His Body

If the Victim be allowed to lie in his wet Clothes after he has been taken from the water, he will become cold much sooner; his blood will clot much more swiftly, and the last Spark of Life will generally be quenched long before the time which is experienced in others to whose treatment greater Care has been devoted. Therefore, the attempts at resuscitation should, if possible, not be made in a Damp Room; consequently, when the Victim has been placed on the straw bed (p. 30), an Eider-Down or a Blanket should be laid both under and over him, so that only his face is free. He can most conveniently be moved and turned as required in such a blanket, or if this is not at hand, in a sheet. The Hamburgische Gesellschaft has also bought woollen Dressing Gowns and Night Caps to be kept for public use in their life-saving chests.

b. Hot Baths

These have been used for the same purpose. The Drowned Person was placed in a spacious Trough, a Bath Tub, etc., with only the head above the water. Bladders or bottles have been filled with hot water and placed on the pit of the Stomach, on the Reproductive Organs, under the Armpits and around the Limbs. Instead of water, Draff has also been used for the same purpose. Wine or strong Spirit and Water have been mixed, and a woollen cloth soaked in this mixture has then been used as a Fomentation. The Victim has been placed in front of the Fire; hot stones or something similar have been applied to the soles of

his feet; or he has been rubbed with a Warming Pan along the spine. Dry baths of Ashes, Salt, Sand or Earth heated over the fire have been used; indeed, the entire cold body has been buried right up to the neck in heaps of Horse Dung or in warm swampy Marshes. Where it could be done, a large Animal has hastily been killed and skinned, and the Victim has been wrapped up in the Hide. In Summer, he has in open air been exposed to the direct effect of the Sun. Attempts have been made to warm, in particular, Children by laying them naked in the bed of adult and healthy persons, etc.

All these means have been used; most of them with great Benefit in individual cases. Some of them are so abominable that they will hardly ever win the Approval of the Multitude. Only in towns where public measures have been taken, is it possible for the Doctor to choose the best Remedy; elsewhere he must be content with the one nearest at hand. All the Remedies involve certain Disadvantages. Generally, some time is wasted in procuring the requisite Means; their use is also an impediment to the Doctor in his more important task: to start the respiration again. This is also the case where electricity is employed (p. 64); the degree of heat of these remedies is most often indeterminate, sometimes too high, sometimes too low, usually is not of sufficient duration, and yet the Hotness of the Bath should always be in a suitable relation to the body temperature of the Asphyxiated Person. If it be too cold, it will divert the body heat much more quickly than the air and is harmful (p. 60); if it be excessively hot, it will quench life completely. The body temperature of a healthy Human Being is, as is known, 97°. In a Drowned Person it may be reduced by 20°

or more without necessarily entailing Death. If, in such a case, heat of 80° or more were applied, then every Hope of Recovery would indisputably vanish. From this it is seen why he who is drowned in Winter, and who has lain for some time in the water and is stiff and cold, should never be put into a lukewarm Bath immediately, but should first be covered and rubbed with Snow or ice-cold Water until his body temperature is raised little by little, and he can then finally be exposed to greater Warmth gradually. The necessity of this has been sufficiently borne out by experiments on both Fruit and Animals. Therefore, whenever Life-saving Measures are undertaken, a *Thermometer* should be at hand; it should be inserted into the Pharynx of the Victim or be placed under his Armpits or under his Tongue, and thus is ascertained the degree of heat which his body has retained. The Bath could then always be used some degrees warmer than the body is found to be, and its temperature could be afterwards increased in a certain relation to the progress of the recovery, although it should hardly ever be higher than about the 80th degree. Water is found everywhere; its heat spreads evenly and can be kept constant, or increased or decreased as required. A lukewarm Bath—for which purpose the Hamburgische Gesellschaft has had a suitable Bath Tub of copper made—therefore deserves general preference over the other remedies. Such a bath also cleanses the surface of the body and renders the skin supple; indeed, heat, *per se*, activates the Vital Powers; further details of this are given later (p. 72).

Among all means of resuscitation, Nature has none which can be applied so directly to the Heart or produce such a rapid and potent effect as:—

c. Electricity

The Heart has a tolerably high degree of excitability, which it retains for even a long time after life has become extinct in the Diaphragm, Stomach and Intestines. In the days of health, it beats incessantly, and, as is known, is the Agent which circulates the blood. Its movements are involuntary, but yet seem partially to depend on the nerves (p. 70). By these, we find that emotional excitements extend their effect to the blood circulation.

In the Natural State, warm oxygenated blood is the specific stimulus, by whose influence the heart is kept in constant motion. The blood oxygen is probably even the source of its excitability. It then beats from 60 to 90 times a minute. In a Drowned Person, this motion is gradually weakened, due to the cause we have previously stated (p. 39). Then the Heart contracts with little Force, which gives only a slight impetus to the furtherance of blood circulation. Beats also occur at much longer intervals, often only a few times in a minute; indeed, after the lapse of some time the movements cease completely before the Excitability has become completely extinct. If, then by the insufflation of air into the Lungs (p. 44) that choking resistance to blood circulation has been overcome (p. 39), and the Heart in spite of this is still unable to propel the blood from its right to its left chamber, it is then necessary that all conceivable help must be aimed at artificially reviving the excitability of the Heart and thus increasing its contractive Power. If this be achieved—while the lungs are filled with Pure Air—it promises, as has also been confirmed by experience, a most striking effect. It is in Electricity that

we find the most potent remedy for this end. Experience and Experiments have shown that Electrical Particles, like Free Heat, can flow through all parts of the Living Body without being retained by any known organ; that it can be artificially led towards individual Organs; and that it is evidently able to arouse the dormant excitability to powerful manifestations. Thus, what should then more strongly be able to arouse the Hopes of the Physician? What should better be able to give him Confidence in this means than these recognised and incontestable Properties which appear so obviously from its effect? All other so-called Cardiac Stimulants are of no other Use than this: either they bear witness to the obscure and incorrect concepts of our Forefathers; or they exert an effect quite different from what been believed, on quite different Organs, perhaps scarcely even by sympathy on the Heart (p. 70). An Electric Shock applied across the chest, from the right to the left side, directly on the large blood vessels of the Heart and Lungs—such a Shock of a suitable strength, applied when the lungs are filled with Pure Atmosphere or Vital Air, is the best *Cardiacum* in a Drowned Person. The insufflation of air and electricity should therefore always be used in combination; for if the Lungs have not been inflated in advance, the effect of electricity is not only less useful, but may even be detrimental. The Heart would exhaust its power and yet the blood would not be propelled through the Lungs.

In the application of electricity, heed should be taken that the Lifeless Body has been carefully wiped off. If not, Moisture removes much of the Electical Matter, so that the purpose may easily not be achieved. Still more important is it that this Remedy, like Hot Baths

(p. 62), be used in a strength relative to the activity of the suppressed Vital Powers. From several experiments made by our perspicacious ABILDGAARD*) and later repeated in England it is clear that small Electric Shocks to a Drowned Person will always have a far more desirable Effect than more violent ones; that the latter, contrary to the desired purpose, are an obstacle to the recovery or may, indeed, just like Lightning, quench the last Remainder of the Excitability. Thus, the more the Vital Powers are impaired, and the longer respiration has been suppressed, the more cautiously should Electricity be applied. It is always wise to start with very slight shocks, the Strength of which has been predetermined by means of an Electrometer. Such a shock is imparted to the weak Heart, at first every second or third time the lungs are expanded; later during the progress of the resuscitation the Shock is evenly increased in strength and is at last applied after each insufflation of air into the Lungs. This should, as far as possible, be kept in step with the increasing movements of the Heart.

Another, but less efficient, remedy is: —

d. Shaking the Lifeless Body

A strong man seizes the Victim under the arms and lifts the upper part of his trunk to his chest, while another person supports the lower part of his Body by holding on to both legs. Thus, the Victim is shaken by the two persons for one or two minutes with suitable vigour, so that the intestines of the Victim are moved about. By this treatment the Vital Organs are stimu-

*) Collect. Soc. medic. Hafn., Anno 1775, vol. II, p. 157.

lated, and the Heart may possibly be aroused to circulate the stagnant blood. As compared with the previously mentioned remedies, this one must be supposed less valuable; but as its use does not easily entail harmful Consequences and does not require any Skill or Apparatus, nevertheless it deserves to be given a Trial if no other remedies for resuscitation are at hand. Several trustworthy reports relate how Asphyxiated Persons who have been brought, with disgraceful Carelessness, too early to the Grave have suddenly been aroused by an inadvertent bump against their Coffins! A similar effect has occasionally been obtained by a blow with a clenched fist between the Shoulders of the Victim. If this is to be attempted, he should first be placed in the sitting position.

Finally, we should add: —

e. Rubbing the Body

This operation is carried out with either the bare hand, or with it covered with a piece of dry flannel, the Skin of a Hare or something similar. It has also been suggested that the hand should be rubbed with Oil; or that flannelette with Amber, Gum Benzoin or other fragrant substances should be burnt; or that during the rubbing strong Spirits, *Eau de la vande*, volatile Alkaline Salt, etc. should be poured on the skin. This treatment may, both indirectly by its effect on the Nerves (p. 73) and more directly, contribute to the furtherance of the blood circulation. By this the excitability of the arteries is aroused, and the power of the veins to return the blood to the Heart is supported. However, it should always be borne in mind that this effect does not extend to the *Pulmonary Veins*, which

cannot be reached by the Physician's hands because of their position in the interior of the chest; and that in the Great Artery (*Aorta*), which is moreover usually empty, the blood cannot be pushed forwards in the reverse direction because this is prevented by the semi-lunar valves at the Heart. Consequently, the left or posterior chambers of the Heart cannot be filled with blood by rubbing.

From this it may likewise be deduced that this means should also be used with caution. If the right chambers of the Heart are still filled with blood, and an unimpeded passage of the blood through the lungs has not been provided, then the rubbing may very easily do harm, especially if the Victim is Plethoric or suffers from a weak Chest. Insufflation of air should therefore also be tried before recourse is taken to this means. Only when this has been done, and the blood circulation has been started again by electric shocks, may lenient rubbing be used with advantage in order to support the powerless Heart*).

- *) The transfer of blood from a Living Animal into a apparently Dead Person (*Transfusio Sanguinis*) has, as is known, fallen into disuse and been rendered ridiculous because of some unsuccessful experiments. If, in these experiments, due regard had been paid to the hindrances which the arrested respiration placed in the way of the circulation of the Blood; if attempts had been made to overcome these hindrances by alternate inflation and deflation of the Lungs; if one of the veins on the neck, which lead directly to the Heart, had been chosen instead of one on the Arm; and if greater care had been taken in preventing the blood from clotting during its transfusion into the Lifeless Person, these experiments would probably have led to a more successful outcome. It would therefore be a Praiseworthy Act

4. *The Suppressed Nervous Power Should Be Re-activated*

No field of Natural Science is shrouded in a more impenetrable Darkness than our Knowledge of the Nerves. In the study of the function of these structures even the most sagacious investigators must stop in admiration and admit his Incompetence in tracing the Steps of Nature. We can see that the Nerves are connected with the brain, and that they extend their branches to the most distant Parts of the Body. We can conclude that they alone are the organs of sensation, and that foreign bodies only by their in-

if some person would repeat these experiments under due precautions. No other means promises greater advantages; warm oxygenated Blood is the most efficacious stimulant to the Heart. It would be easy to affix a small Container of caoutchouc to the tube through which the blood is led into the vein on the Neck of the Victim; by squeezing this Container the blood could be speeded towards the heart. Once circulation has been started again, the volume of the blood could be reduced suitably, in proportion to the amount which has been transfused into the body, by bleeding a vein on the arm. The most recent successful experiment which we know of was made in the year 1790 by Dr. HARWOOD, of Cambridge. However, from Professor TODE's Health Journal (*Sundheds-Journalen*, July 1796) we learn that the attention which this Remedy deserves has been devoted to it in this Country at a more recent date. On the other hand, in our opinion, less benefit is promised by the injection of Medicaments into veins of the Victim (*Chirurgia infusoria*). The most recent experiments by REGNAUDOT (*Histoire de la Société Royale de Médecine*, vol. 2, p. 250) have neither been favourable nor revealed any evidence to support this Remedy.

fluence on them can arouse Sensory Impressions on our organs. Consequently, we can conceive of them as being conductors of a fine, fluid elastic *Medium* which constitutes that incomprehensible Bond between the Soul and the Animal Body. We can recognise the great similarity between this Medium and the fundamental Essence of Electricity. We can convince ourselves that only through the nerves does the Soul possess its unrestricted control of the Muscles which exercise all voluntary movements; but from all this we cannot deduce how the Nervous System controls the Animal Oeconomy, or how the power and effect of this System can be directed and changed by the use of Medicaments.

In the choice of the remedies which should re-activate the suppressed Nervous Power our only Mentor is Experience; it is this that teaches us by which means the Sensations of the entire System can be increased or decreased; by Experience we learn which Nerves are principally attacked by this or that means, and how and with what degree of strength these means can be used without causing harm. Thus, we then choose the most powerful and the most reliable of all those we know and apply them to such parts as in the time of health are the most sensitive, and whose nerves stand in the most intimate Relationship to other Vital Organs.

But although we do not clearly comprehend how the so-called stimulants act on the Nerves, our Knowledge of the mutual relation of the Vital Functions is sufficient for us to realise the Benefit which can be derived from these means in the resuscitation of the Asphyxiated Victim. It was formerly believed that the power of the Nerves did not exert any direct in-

fluence on the Heart. Stimulation of the Nerves which accompany the Coronary Arteries into the interior of the Heart had failed to start the heart beat again*), and the Heart may be re-activated to circulate the blood both by insufflation of air into the Lungs and by the application of Electricity, even a long time after division or ligation of the Spinal Cord, the Inter-costal Nerve and the Eighth Pair**). It was therefore believed that the oxygen of the blood and the Electric Matter might, perhaps, exert a direct influence on the excitability of the Heart, and that this power—so it was said—in this organ existed independently, without any necessary connexion with the nerves. But, as recently the excitability of the Heart has been re-started by a metallic irritant applied to the cardiac nerves; as, besides, the dependence of this power on the Nerves is for obvious reasons beyond any doubt***); and as this latter Experiment may be explained by the energy of the Nerves (p. 71), it then seems if we may also have some hope of an indirect influence of stimulants on the Heart. Yet it is undeniable that all relevant means have a more perceptible effect on the other organs. In these, we find a more concordant Harmony between Sensation and the Motive power; in these, the excitability may more easily be re-aroused by stimulation of the nerves. We

*) See *Ant. Scarpa's* magnificent *Tabulae neurologicae ad illustrandam hist. anatom. cardiacorum nervorum*, 1794.

***) This experiment was made by CRUIKSCHANK. See *Auserlesene Abh. für praktische Aerzte*, vol. 6, p. 734.

***)) See Pfaff: *Über thierische Elektrizität und Reizbarkeit*, Leipzig 1795.

learn this from countless experiments made both on living Animals and on amputated Limbs.

If Medical Science can thus re-excite the ability of the nervous system to perceive Sense Impressions, we may also hope that the relevant means according to the previously mentioned Harmony may extend their power to the Natural and Animal Activities (*Functiones naturales & animales*). Moreover, respiration, which is the most important of the Vital Activities (*Functiones vitales*) operating likewise through the agency of the Nerves, is also subject to the Will and Soul, although to a more limited extent. From this it then follows that by means of the stimulants we may affect the agents (p. 55) which start respiration again.

A Drowned Person loses all sensation long before excitability leaves his Muscles. In this lifeless state, the Nerves consequently cannot convey to the Soul any impression which they have received. Nevertheless the Nervous System retains an inherent *Energy* independent of all Consciousness and Sensation, by which the sympathy of the organs is maintained, at least inasmuch as the involuntary contractions of the Muscles can be excited by stimulants before sensation returns. This is corroborated especially by newer Experiments on Animal Electricity*). This Energy fades out only later, together with the body heat. It is this that teaches us that Man does not die suddenly, but little by little, and that there is still hope of his Revival as long as stimulants exert the slightest effect. Not until this effect is imperceptible should the Doctor—indeed, not until that time can he with Assurance and

*) See Phys. oeconomisk medico-chir. Bibl., vols. 1 and 2, 1794, and vol. 5, 1794.

a Clear Conscience—relinquish his Endeavours to recover the Victim from Death (cf. p. 54 and the footnote p. 43).

Thus, stimulants generally exert their action on both the Nervous and Muscular Systems; so closely concordant is the connexion between these agents. All means that increase the suppressed sensation also re-activate the excitability. The transition from Energy to a freer manifestation of the nervous power is progressive and almost imperceptible; together with it, the Animal Heat usually increases. Through Energy the Art of Medicine influences the Excitability, which, in turn, starts respiration again and hence the Heart. The circulation of blood recommences, and the normal functions of the body are resumed. From this it can be seen to what extent all the stimulants exert their Action, each in its own way, for the furtherance of the desired Aim of the Doctor; and how necessary it is to use each of these at the proper Time and in the proper Way. The most natural among these means is:—

a. Heat

Heat keeps the Blood and Fat liquid, preserves and increases the Energy of the Nerves and the Excitability of the Muscles. It wakes up the Animals which hibernate throughout the Winter. It should therefore be carefully attempted to maintain the Body Heat of a Drowned Person by the means mentioned on pages 60 and 61. A higher degree of Artificial Heat has also been used as a stimulant for the Nerves. This purpose may be achieved by focusing the Sun's rays by a Burning Glass; by using red-hot Irons, or, still better, by

filling small Bladders with boiling Water and keeping them, for a moment at a time, under the Soles of the Feet, on the Pit of the Stomach and in similar places. However, these means do not promise any actual benefit until resuscitation has made some progress.

From time immemorial:—

b. Rubbing and Brushing

on the surface of the lifeless Body has also been used; the object of this procedure was to elicit Warmth and impart stimulation to the Nerves. This method does actually promise these advantages when it is used at the proper time, persistently and with moderation. Further benefit may, perhaps, be derived from it inasmuch as, according to more recent experiments, it arouses the Electricity of the Nerves. We have already shown (p. 66) that it exerts an influence on blood circulation, and therefore should be used with due Caution. Several Learned Men have expressed the opinion that the rubbing would be more effective if the Operator first dip his hands into warm Oil, or if strong or other Spirits, or a liquid volatile Alkaline Salt or similar liquids be poured on to the skin. But as the oil necessarily weakens the effect of the rubbing on the Nerves, and as all volatile Media promote emanation, by which they more swiftly conduct away the Animal Heat*), and consequently (p. 72) quench the excitability, then we believe that this operation would best be performed by a dry stiff Brush, a woollen or coarse Linen Cloth, or by the bare Hand (p. 66), care being taken that all Moisture is avoided. At any

*) For convincing experiments on this subject, see Kammerherre HAUCH's Textbook of Physics, p. 231.

rate, the volatile Media should be used only for a short while and only in a few places—and not until signs of recovery have appeared—and at once after their use the Skin should be carefully wiped and covered.

Another means for the same End is:—

c. Electricity

That moderate Electric Shocks exert a direct action on the Heart has already been explained in detail (p. 63). Here it will suffice to add that the self-same means, used with the same precautions, is incontestably the most potent nervous stimulant which is available to Medical Art in the resuscitation of Drowned Persons, and that its effect on the asphyxiated body has sometimes been strikingly apparent long after all other means have been tried in vain. Those versed in Natural Science easily realise that such Electric Shocks give the best promise when applied along the Spine, on the Pit of the Stomach and on the Sides of the Neck.

d. Invigorating Stimulants for the Stomach

The Stomach is connected with the intestines; it is a sensitive and excitable organ and is closely related to the entire body. The so-called Cardiac Stimulants (p. 64) produce their bracing effect only by their action on the nerves of the Stomach. Thus, a mouthful of wine, at the very moment it is swallowed, is a strong Refreshment for an otherwise healthy, but exhausted Human Being; his entire body is inspired with new life and strength long before the Remedy has passed into the blood stream. This common Experience thus directly suggests that the use of such Remedies must

be very suitable in an apparently Drowned Person. But as, in this insensible state, Man is unable to swallow, artificial means must necessarily be applied in order to bring such Remedies into the Stomach. For this purpose, a flexible, conical Tube of a suitable length made of Elastic Gum is used. Into this Tube is inserted a fairly thick whalebone Probe, to the pointed end of which is affixed a piece of soft sponge. The latter serves to guide the tip of the Tube and the former imparts to it the requisite rigidity, so that the Tube is readily introduced into the Stomach. When this has been done, the whalebone is withdrawn and a small glass Funnel is put into the upper end of the Tube, through which the Fluid to be used is poured. Should this attempt fail, the Fluid is poured into a smaller bladder, which is tied to the tube; by squeezing the bladder, the Fluid may then easily be forced down*). A good Madeira or Rhenish Wine should preferably be used. In those who are accustomed to alcoholic drinks, strong Spirits, Rum, etc. may be used, or these may be mixed with fiery essences or a volatile Alkaline Salt. The experiments which have been made on Animals show that invigorating stimulants thus used have often produced an effect which by far surpassed all ex-

*) In earlier times, a rigid curved silver Tube was used for this purpose; one end of this Tube was rounded into the shape of an Olive and provided with small holes; a Syringe was screwed on to the other end, and the fluid was then injected into the Stomach (see CHOPART's and DESAULT's *Anleitung zur Kenntniss aller chir. Krankh.*, vol. 1, p. 340). Later, the previously mentioned improved stomach catheter came into use. It is also described in Danish and recommended by Professor BØTCHER in his *Physical Yearbook* (*Physikalske Aarbog* 1793, p. 196).

pectations. However, too great a quantity should not be administered, both because this might cause excessive distension of the Stomach and thus impair the function of the Diaphragm, and also because it might have a harmful after-effect.

e. Emetics

have been given in the same way. Formerly, the incorrect opinion was held that Drowning Persons in their agony swallowed large quantities of Water. For this reason, such victims were suspended by the legs or rolled over a Barrel, and recourse was also taken to the use of Emetics. Later, the falseness of the presupposition of this Plan of Treatment was realised, and these far too violent maltreatments were again abandoned (p. 2); but nevertheless Emetics still had their advocates, and were used in cases where they did not promise the slightest benefit. The belief that this remedy possessed a specific power to affect the sensitive Nerves of the Stomach; that it might reactivate the wormlike movement of both the Stomach and the Intestine; that its effect was accompanied by an effort in the entire body, which was held to be beneficial; and that in many other cases where the Stomach was burdened by crudities, etc., it contributed appreciably to increase the nervous power, seems to have supported and maintained the credence given to this remedy. Only in more recent times have these reasons completely lost their value. At the present time, most Doctors concur that the Faintness and Sickness which an Emetic inflicts upon even the healthiest Human Being and the general weakness which the pulse so distinctly reveals under its influence do

not at all concord with the objective of the Doctor, viz. to re-arouse the Vital Powers. For this reason, this means has now, both in Hamburg and in England, been declared suspect, and nearly everywhere has it fallen into disuse. As long as Respiration has not started again, it should never be used, and once this Vital Function has again been resumed, it must be supposed to be necessary only on very rare occasions, if the Victim is neither drunk nor had a substantial meal just before he fell into the water.

Just as the objective of the use of these Means is to excite the nerves of the Stomach, attempts have also been made to apply stimulation to the Bowels. The Means for this Purpose is especially:—

f. Clysters

Some years ago, *Tobacco Smoke* was considered to be the most efficacious Remedy which could be used for this purpose. A helper filled an ordinary pipe with Canaster or some other strong Tobacco, set it well alight, filled his mouth with Smoke and blew it through a Tube into the Rectum. Alternatively, the stem of a pipe was introduced into the Rectum, a paper Funnel or something similar was placed over the bowl and the Smoke was simply blown in. Another method was that the bowls of two pipes were bound together; the stem of one was introduced into the Rectum and that of another into the Mouth of the helper. The disagreeableness of this operation gave rise to the invention of a large number of Bellows, Blowers, Pumps and other Instruments, of which one or the other was

established for public use in several places*). By means of these Instruments it was easier and quicker to impel a considerable amount of warm Smoke into the Bowels of the Victim. This operation was usually continued for a couple of minutes and then interrupted for a short while for fear lest the Smoke should be too hot and the Bowels be excessively distended. During the introduction of the smoke the Abdomen was rubbed with the palm of the hand to give a better distribution of the Smoke. Thus, it was believed that the insufflated Smoke by its Elasticity, Warmth and Pungency would exert a beneficial influence on the Nervous Energy and through this strongly promote the wormlike movement of the intestine. The Dutch have particularly conceived an excessive Confidence in this means and have used it in a large number of cases with apparent benefit. Yet it is likely that dubious experiences have here, as was also the case with Blood Letting (p. 54), misled Doctors to estimate its worth as greater than it actually deserves. Experiments which have recently been made on drowned Quadrupeds have shown that tobacco Smoke introduced into the Bowels, within a short while quenches, instead of arousing, the motive power of the Heart and other Muscles. In addition to its excitant property it also possesses a stupefying power to such a high degree that it may, with the greatest justification, be doubted if the latter does not ruin the effect of the former.

*) The most well-known of these Instruments were invented by GAUBIUS, LAMMERSDORF, PIA, FELLER, REILPFLUG, FIDELE, CARMINE and OSIANDER. A survey of the history of these Instruments is given in ROZIER's *Journal des physiques*, vol. 8, p. 271.

The Tobacco Smoke reveals this property far too distinctly by the Weakness, Nausea and Cold Sweats which usually accompany its use, even in the most healthy individuals. Accordingly, this remedy is also used in maladies which, as compared with the condition of a Drowned Person, are of quite the opposite nature, and in which the objective of the Doctor is to weaken or diminish sensation and excitability. Moreover, the distension of the Bowels may constitute a mechanical Obstacle to the movements of the diaphragm during inspiration, and the good effect of tobacco-smoke Clysters which is thought to have been observed may either be ascribed to Nature itself or to the warmth and air which are brought into the body together with the Smoke. For these reasons, this remedy is now falling into disuse. In Hamburg, it is not used as long as the Victim is unconscious, and only then in the rare cases in which the Physician may find a rapid evacuation necessary. In England, distrust in its effect has likewise been conceived. For the purpose cited, other stimulants are preferred: a simple Clyster of Oatmeal Gruel, Salt and Oil; a more reliable remedy is a mixture of Water, Mustard and Oil of Turpentine, smoothed by a fresh Egg Yolk or similar substance; the Physician will find the necessary directions in the papers of GAUBIUS, DEGORTER, HARTMAN, PLENK, NICOLAI and others. The use of a clyster of warm Vital Air has recently been suggested, but the benefit derived from this has not as yet been borne out by experience.

Another effective remedy for apparently lifeless Human Beings is:—

g. The Drip Bath

The penetrating impression which a Drop of ice-cold water arouses in a healthy Human Being when it falls from a certain height on a sensitive part of his Body is well known. On countless occasions, persons in the deepest fainting fits have recovered consciousness when a little cold water is sprinkled on the Face or Chest, and numerous still-born children have been resuscitated by this means alone. The Drip Bath exerts its effect particularly from the fact that its coldness for a moment deprives a few sensitive points on the body of their free Heat. If benefit is to be derived from this method, there should be a perceptible difference between the temperature of the Water and that of the asphyxiated Body, and the nerves of the skin should still possess some sensibility. The reason is to be found here why this remedy is less effective in a Drowned Person than in fainting, still-birth, suffocation or similar states, where the body heat has not been considerably reduced. The Bath can only be effective when the Victim has been under water for only a short while, or when his reduced body heat has again been increased by the incessant application of other Remedies. The most effective places in which this Bath can be applied are apparently the Pit of the Stomach and the Sides of the Neck. It should be attempted for only a short while at a time, and the body should then at once be wiped (p. 60).

h. Other Stimulants to the Skin

Under these we include: whipping with Nettles; Cupping; application of Cantharides or rubbing with

a Powder Extract thereof or similar Acrid Agents; Scarification under the Feet or in other sensitive places; and the use of red-hot Irons. Save for the last Remedy, which may be tried without harm, and, indeed, ought to be tried, before the hope of recovery of the Drowned Person is given up and his dead body is left, we find no grounds to recommend the others, as they may just as well be replaced by those mentioned on pages 72, 74 and 80.

Finally, Benefit may be derived from the Application of:—

i. Particular Stimulants to the Sense Organs

The Eye, Ear, and Nose have, in addition to their general ability of feeling, their own particular Sensibility, by which each organ receives special impressions: the Eye is stimulated exclusively by light, the Ear by sound, and volatile agents reveal their smell only by their effect on the Nose. These incomprehensible Natural Phenomena can also be utilised in the practice of Medical Science. The sharp light from a Lamp burning in Vital Air under a Bell Glass must necessarily impart a far more intense impression on the retina than does ordinary daylight; so do the rays of the sun converged by means of a concave mirror. The ringing of a Bell held near to the Ear has a much stronger effect on it than any other ordinary sound. Acrid volatile agents: Spirits of Hartshorn, Snuff, Hellebore, Burning Sulphur and the like, must principally attack the Nose. Of these several means, those which especially affect the sense of Smell have been utilised, because this sense is intimately related to the

respiratory muscles. The agents are held under the Nose, or they are blown in through a small tube; those that are liquid may be instilled or injected. Caution should be exercised in using sulphurous vapours, especially when spontaneous respiration has been resumed. The progress of resuscitation is controlled by following the effect of light on the iris of the Eye.

These then are the means by which attempts have been made to arouse apparently Drowned Persons from their Dormant State. During their application, is the slightest sign of life noticed? Does the Animal Heat increase? Does the Excitability become stronger? Does the Pupil contract? Does the slightest movement of the Muscles appear? Do the Heart and Arteries begin to beat? Does a sound from the Chest, a weak moan, a sigh, or a rumbling noise from the Abdomen become audible? Do the Jaws clench together? Does the colour of the Cheeks change from bluish pale into bright red? If so, then there is the greatest Hope of the Recovery of the Victim. If so, it is natural that the Doctor should re-double his Efforts and Attention until the Vital Functions are performed by the still weak body's own force.

During the resuscitation a teaspoonful of lukewarm water should now and again be poured into the Mouth of the Victim in order to see if he begins to swallow. If this function is also resumed, he should be carefully placed in a slightly warmed Bed, with the head raised, and his Legs wrapped in warm Flannel. He should then be given an infusion of Tea to drink, a teaspoonful at a time, or Whey, or lukewarm Beer, or Wine and Water, or a few drops of Hoffmann's Anodyne, Vitriol Naphtha, Spirits of Hartshorn, etc. in order to promote the perspiration of the Body. He

should not be left alone until he is fully conscious. Then he will usually fall into a quiet Sleep, from which he, as a rule, awakes with his former Health regained. If fever should occur, with an oppressive feeling and pain in the Head or Chest, he should be bled or otherwise treated with antiphlogistic Remedies.

A Brief Survey of the Sequence in Which the Means of Resuscitation Should Be Applied

- 1) When the Victim has been taken out of the Water as quickly as possible and with due Caution (p. 22 and p. 24) and has been
- 2) carried to the nearest convenient Place (p. 24 and p. 29),
- 3) his Clothes are carefully taken off (p. 30),
- 4) after which his Body is wiped well (p. 60),
- 5) and he is placed in a comfortable position on a bed of straw (p. 30);
- 6) here he is carefully covered (p. 60).
- 7) If he be stiff from Cold, he is at once rubbed with Snow or bathed in ice-cold Water (p. 62).
- 8) Then his Mouth, Pharynx and Nose are cleansed (p. 42),
- 9) his Chest is compressed (p. 43);
- 10) insufflation of Air is at once commenced (p. 44).
- 11) If no Air penetrates into the Lungs, the Catheter is inserted (p. 53).
- 12) If this proves impossible, Tracheotomy is performed (p. 53).
- 13) During the insufflation, Electric Shocks are applied to the Heart (p. 63); and
- 14) the Blood is coaxed towards the Chest (p. 66).
- 15) This is continued without Interruption for at least one quarter of an Hour.
- 16) Meanwhile, the Body Temperature is ascertained now and then (p. 62).

- 17) If the Victim does not regain Consciousness, the Insufflation of Air and the Application of Electricity are stopped for a while, and an invigorating Stimulant is administered into the Stomach (p. 75).
- 18) Bladders filled with hot Water are placed on the Pit of the Stomach, under the Feet, etc. (p. 73);
- 19) he is given a stimulant Clyster (p. 77),
- 20) the Surface of his Body is rubbed and brushed (p. 73);
- 21) he is shaken by two men (p. 65);
- 22) he is placed in a suitably hot Bath (p. 60),
- 23) and particular Stimulants to the Sense Organs are applied (p. 81).
- 24) After the lapse of a few Minutes he is taken out of the Bath, wiped well, and covered as before (p. 60).
- 25) The Insufflation of Air is resumed (p. 44), and
- 26) electric Shocks are again applied to the Heart (p. 63)
- 27) as well as to the Spinal Cord and the Neck (p. 74).
- 28) The Drip Bath may also be given a Trial (p. 80).
- 29) These Remedies are thus applied alternately for a Period of several Hours until all Hope of Recovery has been abandoned (p. 72).
- 30) Finally, the application of red-hot Irons may be attempted (p. 81).
- 31) If Consciousness returns, the Victim is put to Bed (p. 82) and is refreshed with a suitable Beverage.
- 32) The rest of the Treatment should be adapted to his State of Recovery.

All these Measures can be taken when the Physician has four or five helpers; other superfluous on-lookers are only Hindrances and should be sent away. Anybody can perform the Operations described in the first eight sections. In the meantime, a Doctor or another Enlightened Person who can conduct the rest of the Treatment should be sent for. The most potent Means should as far as possible be used at the same time, although always under the requisite Precautions. During the procedure the unskilled Helpers should be encouraged to unremitting Diligence, and one should not entertain any doubt of seeing one's endeavours being crowned by a Successful Outcome. No-one should believe that he has done his Duty until he has rendered all the Help he owes the Victim.

The Life-saving Equipment Required by the Physician

- 1) A small Rod of Whalebone with a Piece of Sponge attached to the end (p. 42).
- 2) A wide Tube for Insufflation of Air (p. 46).
- 3) A simple Bellows (p. 48) or, still better,
- 4) Gorcy's Double Bellows (see Fig. 9 and p. 50).
- 5) A curved silver Tube or Tracheal Catheter (p. 53).
- 6) Instruments for Tracheotomy, a Bistoury, a Pair of Thumb Forceps, a small silver Tube, a Pair of Scissors, a Sponge, etc.
- 7) Several Glasses of Vital Air.
- 8) An Electrical Machine with suitable Appliances (p. 63 and p. 74).

- 9) A flexible Tube and Syringe to match (p. 75).
- 10) A Clyster Syringe (p. 77).
- 11) Some Bladders (p. 73).
- 12) Spirits of Hartshorn, Vitriol Naphtha, Essence of Cinchona or Cinnamon, Madeira Wine, some Herbs for Tea (p. 82).
- 13) A Thermometer (p. 62).

With the exception of the Electrical Machine, all the other Instruments can be kept in a small Chest, which can easily be carried by one man.

Legend for the Copper Engraving

Fig. I showing the "Seeker."

- a, its wooden pole.
- b, its fork-shaped iron.

Figs. II and III showing the Catching Forceps, open and closed, respectively.

- a, a round wooden pole.
- b, an iron pin, by which the forceps are fixed.
- c, iron mounting of the wooden pole.
- d, a transverse pin on which the arms are moved.
- e, c, the curved arms of the forceps.
- f, the movable iron ring.
- g, the iron bar with its joints at h, i and d.
- f, the rope for the closure of the arms of the forceps.

Fig. IV showing the Life-saving Ladder.

- a, its upper rung.
- b, the extension pole.

Fig. V showing the Life-boat carried by a man.

- a, b, its stem and stern.
- c, c, c, c, its rectangular basket.
- d, the basket-work chair.

Fig. VI showing the bottom of the Boat.

- a, a, its stem and stern.
- b, b, b, b, the runners on which the boat may slide.
- c, the rectangular opening in the bottom of the boat.

Fig. VII showing the Life-saving Pole.

- a, its cross bar.
- b, b, b, its ropes.
- c, c, c, its wooden balls.

Fig. VIII showing the Carrying Basket.

- a, its curved end.
- b, b, b, b, its carrying rings.
- c, c, the carrying poles.
- d, d, the cross bars of the basket.

Fig. IX showing Gorcy's Double Bellows.

- a, the middle board of the bellows.
- B, b, the side holes of the bellows with suitable valves.
- c, c, a metal tube provided with
- d, a tap.
- e, a bladder with Vital Air.
- f, the copper box of the bellows, with two valves.
- g, the lid of this box.
- h, a flexible tube.
- i, the nozzle of this tube.

Erratum :

Page 39, fifth line from bottom: Oxygen Gas, read Oxygen.

