On the natural immunity against cholera and the prevention of this and other allied diseases by simple physiological means / by C. Godfrey Gümpel.

On the Natural Immunity against Cholera

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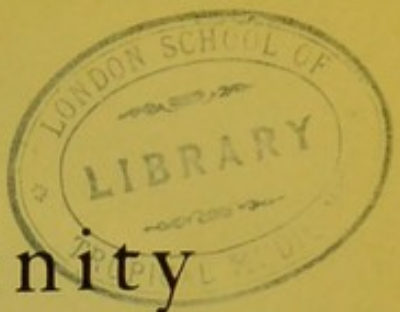

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"In the most violent Epidemics over 90 per cent. of a population are already protected through their Constitutional Immunity; let us endeavour, by the discovery of the cause of this Immunity, to protect the other 10 per cent. and save half of these from an untimely death."—(p. 18.)

BY

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LONDON:
WILLIAMS & NORGATE,
14, HENRIETTA STREET, COVENT GARDEN, W.C.
1894.

PREFACE.

The following lines make no pretence to literary excellence; they have for their object: to promote and assist in the Prevention and Cure of Cholera, and so to serve the welfare of mankind. Only from this standpoint should they be judged and criticised.

The subject is pre-eminently one, which appeals to the Educated Reader—more so in fact, than to the Medical Profession; although it must be admitted, that on questions, appertaining to the health and well-being of the human body, great ignorance exists among the educated classes; even among those who figure in the Daily Press as the Monitors of the General Public.

The reader or critic, whose time and temper will not permit him, to read the following pages consecutively, as in justice they demand, but who—after glancing over the first and the last pages—constructs a picture of the subject "out of his own inner consciousness," will find in the Appendix a synopsis of the contents, which will enable him to form some idea of the train of reasoning, that runs through the dissertation.

The German Edition of this Treatise (originally written in the early part of 1893) was published in August last by Messrs. J. F. Lehmann in Munich, on the recommendation of Professor Dr. Max von Pettenkofer, the great, if not the greatest authority on the subject of Cholera.

London, October, 1894.

"One who undertakes to explain an involved matter to a person of undisciplined intelligence, finds that, though the person has understood each part of the explanation, he has failed to co-ordinate the parts; because the first has dropped out of his mind before the last is reached. This holds not of listeners only, but of many readers."

HERBERT SPENCER,
The Study of Sociology, Postscript.

Der kluge Mann schweift nicht nach dem Fernen,
Um Nahes zu finden;
Und seine Hand greift nicht nach den Sternen,
Um Licht anzuzünden.

F. BODENSTEDT, Mirza-Schaffy.

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I.

IT is an incontestable fact, that our knowledge of the true Nature of Cholera and of the Prevention and Treatment of this Disease, is most uncertain and incomplete; and that the few achievements in this branch of Medical Science during the last few years, have met with doubt and dissension on the part of a great number of Physicians and Pathologists.

No sooner has a new Hypothesis on the true character of the Disease been suggested, when new facts were discovered, which made it untenable; hence all the latest researches have proved unavailing to bring us any nearer to the solution of this question; and what Dr. Geo. Budd* (p. 117) uttered fifty years ago:

"It will be readily admitted that these changes (just enumerated), although they may serve to explain some of the symptoms of Cholera, do not, of themselves, lead us to any certain knowledge of its real nature;" or what Dr. Mireur (p. 152), declares to be the result of the scientific inquiry into the Epidemic of Marseilles, 1884, that:

"Cholera is a disease, which has caused numberless researches; of which however science does not know as yet its true nature" . . . these dicta can appropriately be repeated as applying at the present moment to our knowledge of the true character of Cholera.

* See Literary References, pp. 65, 66.

The same remarks apply to the treatment of a fully-developed cholera case. Rossbach (p. 189) candidly admits the helplessness of the physician at the bedside of the cholera patient, when he says:

"All former and in no less degree also the present epidemics have, through the hecatombs of victims, forced upon us the conviction, that we are literally powerless against the developed cholera case; and that 50 per cent. of the attacked are doomed to die."

So also Dr. Mireur (p. 125) declares that: "The same doubt, which characterises the inquiry into the nature of the disease, is evinced in the question of the treatment."

And in a graphic manner is this expressed by Dr. D. R. O'Sullivan, in his account of the Hamburg Epidemic of 1892, when he states:

"The decline of the Epidemic is due, not to any medical skill, but to the fact, that the disease has weeded out all the persons with the necessary predisposition."

We can, hence, not escape the admission that, notwithstanding all the Researches, Conferences, Publications and Instructions: Cholera Epidemics still occur; and either in relation to the true nature of the disease—to the cholera poison—or to the many phenomena connected with it: no definite knowledge has been gained. Cholera, as an epidemic—when all conditions for its outbreak are favourable—cannot, with any certainty, be prevented; and in the individual case it cannot be cured—whatever may be asserted to the contrary.*

And this want of an exact acquaintance with the true nature of Cholera, and the absence of all certainty in the means for the treatment of the disease, is best illustrated by a reference to the proposed remedies and to the experiments made upon Cholera-patients.

The following critical remarks—by Dr. Kantarowicz in Forst,

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* It must appear vain and inconsistent to adhere to such an assertion—as it can only serve as a cloak for our ignorance—in face of all the latest admissions and contradictions on the nature and prevention of Cholera; to wit: the remarks of Professor Grüber, of Dr. Metschnikoff and others at the Congress of Hygiene and Demography in Budapest;—the controversies about the true position of the Comma-bacillus in the Etiology of Cholera;—the experiments, with doubtful results, of Dr. Haffkine's in India, &c., &c.

on the advice of Dr. X. for the treatment of Cholera—are extracted from "Hygieia" (Dec. 1892, pp. 146-7):

"For every symptom he has ten remedies which must be successively tried. How the patient can bear such systematic poisoning does not concern Dr. X. He very reasonably recommends at first a light non-irritating diet: broth, yolk of an egg, hot punch; but then he finds it necessary, to add to this latter, Cayenne pepper. After one or two hours follow Opium, Calomel and small doses of Quinine. And so on . . . externally Mustard-poultices; inwardly Ox-gall with Pepsine—then an entire bath, and a foot-bath, to which, since water appears too simple and natural, he adds hydrochloric and nitric acid. . . . . In desperate cases (as Dr. X. jocosely says, as if it were not already a desperate case, to fall into the hands of such a Physician) warm milk with an alkaline salt is to be injected into the veins."

Although this severe criticism is the opinion of a professional colleague—yet it must not be overlooked, that Dr. X. in relation to his patients is acknowledged as an attested "Practitioner," who is accredited by the State to give his opinion upon questions of life and death; and who, if attacked by laymen as to his capabilities, would be protected and defended by most of his professional brethren.

And with astonishment must we read the following:

"Dr. Holmann de Villiers published in the Sem. Med. a method of treating Cholera cases, which has been tried by Dr. Lambotte in Antwerp. Dr. L. took two patients, made an incision of 3 c.m. in the abdomen, and another of 1 c.m. in the inner lining membrane, pulled out by means of pincers the small intestines, fastened these to the abdominal wall, and by the employment of suitable instruments, washed out the intestines, first with a solution of Sublimate* (1 : 3000), and immediately after with a decoction of Coffee, Peppermint-tea and Water;—then replaced the intestines and sewed up the aperture. Both patients died."

The Deutsche Med. Wochenschrift (1892, No. 22, p. 863) adds sarcastically: "We publish this fact to make it better known."†

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* Mercuric Chloride—Corrosive Sublimate.

† "Wir bringen diese Thatsche nur, um sie niedriger zu hängen." This latter expression is adapted from an Anecdote of Frederick the Great, who had a Pasquil upon himself placed lower, that the people might see it better.

II.

It is generally admitted, that several factors are necessary for the outbreak, not only of an Epidemic of Cholera, but also of the individual sporadic case of the disease; namely:

a. The presence of the Cholera-bacillus (or = germ).
(= the *x*; Dr. Koch).

b. Favourable environments; temporary and local disposition
(= the *y*; Prof. Dr. v. Pettenkofer).

c. The Individual Predisposition.
(= the *z*; Prof. Virchow).

On the question of the greater importance of one or the other of these factors, opinions widely differ; the more so, since definite hypotheses on the nature and the cause of the disease have been pressed upon public attention.

Before entering upon an investigation of this question as to the relative importance of these factors in the production of Cholera, it may not be out of place here, to refer to the assertion of some Medical Men, that Cholera is the result of dirt; that it is a Dirt-disease; although abundant evidence is available to prove, that the disease does not always choose places of filth and uncleanliness—but often passes these by, to make its murderous attack in adjacent localities, where a purer atmosphere and better sanitary conditions would make us expect different results.

Rossbach (p. 123) points out in relation to this:

"It is necessary here to bear in mind, that dirt is only one of the many factors that favour the disease. It is hence not surprising that Cholera does not take root and does not spread even under conditions of great dirt. Examples of this have been assiduously collected. In the most filthy suburbs and villages round Paris, viz.: in Chantilly, in Clichy only 11 to 12 per cent. ('per mille?'); in the cleanest of them on the contrary 35 to 55 per cent. (?) of the inhabitants died of Cholera. La Villette (Paris) had (1832) scarcely any cases of disease, although it was exposed to the disgusting exhalations of the enormous accumulations of ordure and of the carrion pits; nay—not a single case of cholera appeared among the workmen, that lived in the very midst of these offensive odours; and in Copenhagen (1855) the men, who were engaged in emptying cess-pools, escaped the disease entirely.

On the other hand we find that the angel of death follows the caravans of the desert, in spite of the pure air, the dry stony ground, the constant change of abode; notwithstanding the absence of accumulated filth and of cess-pools."

A striking proof of the fact: how little absolute influence dirt and a porous soil, saturated with filth, has upon the mortality during a cholera-epidemic, we can find in a report on the Epidemic in Kashmir in 1892, by A. Mitra, as cited in the American Journal of Medical Science (Feb. 1893, p. 232):

"Before the Epidemic appeared, the ground-water level was very low. The soil was infiltrated with decaying vegetable and animal matter, and presented a favourable nidus for the cholera-poison, whenever it might be introduced; and when this happened, the germs found other conditions favourable for the growth of an epidemic. The Kashmirs are notoriously filthy, and 125,000 of them are crowded into the city of Srinagar, which is about the centre of the valley, is two miles long and a mile-and-a-half in its widest part. The city is built on both sides of the river Yhelum, and through the city also runs a canal, the Nalla Mar, which was once used as a water supply, but now is but a string of cess-pools. The population is crowded into 25,000 low, dirty houses, built irregularly on narrow lanes and alleys, which are used as latrines. There is no drainage, and the storm-water washes the filth and ordure into the Nalla Mar and into the river from which the drinking water is obtained, ... the beds and clothes of patients and the bodies of the dead were washed in the river and canal, from which water was drawn for drinking and domestic purposes; and the dejecta of many cases in the boats on the river were thrown into the water, while drinking water for the patients and others in the boats was taken from the same spot almost simultaneously. . .

The first outbreak of the disease was most malignant. It declined far more gradually than it began, and as it abated the type of the disease became less virulent, until finally the last few cases were of an extremely mild nature."

It will be almost impossible, either to find naturally or produce artificially more favourable conditions for the development of Cholera, than those stated above; and it is a wonder that not all the inhabitants

of Srinagar succumbed to the disease, as might have been expected according to the "dirt-theory."

Instead of this, of the total population of Srinagar, only 7·2 per cent. were attacked and 4·6 per cent. died. (Of 125,000 inhabitants 9,041 had the disease, and of these 5,781 died between May 6th and August 15th.)

Mr. Mitra adds: "The drugs used were numerous . . . . all of which appear to have been equally inefficient,"—and we might add with Dr. O'Sullivan (as cited above):

The decline of the Epidemic was due not to any medical skill—or the absence of filth and dirt—but simply to the fact that the disease had weeded out all the persons with the necessary predisposition.

When in Paris in fifty of the dirtiest streets 33 per 1,000, and in fifty of the cleanest streets 19 per 1,000 of the inhabitants succumbed to the disease, it must be borne in mind, that the poorer people lived in the more confined part of the city and hence breathed a more vitiated atmosphere; that through poverty they were more exposed to the dangers of unwholesome food and drink, and that they in consequence developed a greater susceptibility for disease generally.

III.

a. The Cholera-bacillus (= *x*).

Although by many Pathologists considered as doubtful—yet on the whole, evidence seems to be in favour of the assumption, that the Comma-bacillus, discovered by Dr. Robert Koch is the exciting cause of Cholera. It is however still an open question, how far an intimate acquaintance with this micro-organism can assist us in obtaining a precise knowledge of the nature of Cholera, with special reference to the Prevention and Cure of the disease; and whether such knowledge will lead us to the discovery of the necessary means for combating and stamping out this plague of mankind

With the object of gaining some definite knowledge about the pathogenic powers of the Cholera-bacillus, Prof. Dr. Max v. Pettenkofer in Munich (to whom our knowledge of the etiology of the disease is

already greatly indebted)—has made an experiment upon himself, the result of which he has published. He very rightly observes (p. 6) that "indisputable unobjectionable Experiments of Infection with Comma-bacilli can be of value only, if made on human beings.

If similar experiments are made upon guinea-pigs with non-pathogenic micro-organisms, as for instance with bacterium coli communis, it is found that the animals are destroyed, while the bacteria, injected into the body of the animal, multiply, like the comma-bacilli.

The constant presence of the Comma-bacillus in the dejecta of Cholera-patients, simply shows, that this micro-organism has some connection with the Cholera-process; but it is still questionable, whether it alone is the cause of the disease; whether it alone produces Cholera poison."

Prof. v. Pettenkofer considers, that this bacillus can produce Cholera only, when a temporary and local disposition exists—when the environment is favourable. To prove this experimentally, he submitted himself to an infection under most carefully prepared conditions, favourable for the development of the disease; such as neutralising the acid of the gastric juice by means of 1 gram. of bicarbonate of soda dissolved in 100 c.c.m. of water; and with this he took 1 c.c.m. of a powerful, freshly prepared culture of the comma-bacillus.

Although Dr. v. Pettenkofer is 74 years old and feels the weight of years in his constitution, yet he escaped an attack of Cholera and only suffered slightly from Diarrhœa. "How much poison," he says, "must have been produced in my intestines from the millions of bacilli during the eight days! and yet I was not poisoned; kept in excellent health with good appetite; had no tendency to vomiting; no lowering of temperature; no albumen in the urine, &c., and never ceased attending to my daily business;—from which I conclude, that the comma-bacillus is capable of producing Diarrhœa—but not Cholera; either asiatica or nostras."

Prof. v. Pettenkofer does not absolutely deny, that the Comma-bacillus is of some etiological importance; but "he cannot possibly believe, that it is the x, which without the presence of y can produce and develop cholera."

Prof. Hüppe (p. 3) appears to misunderstand Pettenkofer's dicta, when he says: "The Comma-bacillus is, as Pettenkofer once declared, the only reliable factor in the whole cholera question, and only Klein in London and Cunningham in Calcutta consider the bacillus etiologically as non-essential. At all events, there is no Cholera without the Comma-bacillus."

Although immediately following (p. 19) he adds: "It has been found repeatedly, that in very slight cases of diarrhœa, which would have attracted no notice, had cholera not existed at the same time, Cholera-bacilli were found in the evacuations. I myself, on the contrary, have found, that in the dejecta of a typical Cholera case the bacteria **were not present.**"

ALWAYS DOUBT; ALWAYS CONTRADICTION.

And so also in relation to the pathogenic (disease-producing) powers of the bacillus. Referring to the slight attack of diarrhœa in Professor v. Pettenkofer's case, Dr. Schiller makes the following remarks (p. 114):

"In all epidemics, we notice such slight cases of cholera by the side of others, which end fatally; as evidence in Hamburg and Berlin by means of bacteriological researches."

In other words: slight cases of diarrhœa occur with the presence, and fatal cases of cholera occur without the presence of the Comma-bacillus; and the severity of the attack is not dependent on the presence or absence of the disease-producing microbe.

Surely then, we are justified in asking: Is it worth the trouble and expense to spend so much time upon the search for the bacillus?

Dr. Schiller (p. 115) adds: "If all indications agree, the diagnosis 'Cholera-asiatica' is assured."

Well! **and what then?** Have we thereby made the slightest advance towards preventing or curing the disease? especially as such bacteriological researches often occupy twelve to twenty-four hours and more, during which the patient has time enough to contract the disease and die two or three times!

"Sometimes it takes three, seven, yes even fifteen days, until the surface-film of the Comma-bacillus is properly formed; it is hence

prudent, not to interrupt the observation too soon" (p. 115) . . . . with the object no doubt, of informing the dead body, whether cholera-asiatica or cholera nostras was the cause of death! *

In a similar strain writes Dr. Dornblüth, Rostock (p. 119). "**Although Cholera can only be produced by swallowing Bacilli, yet it is not always certain that Cholera is the result, when Bacilli are swallowed**" (The original printed in large type). Nevertheless he declares: "It may be mere accident, that among a number of people, who live near each other in the same place, perhaps the same house, or the same family—some remain healthy while others are attacked; also that of these latter, some suffer slightly, others severely; some only from diarrhœa, while others die:—may be due to the fact that these latter have swallowed a greater and the former a lesser number of Bacilli." (Although he has just assured us that Cholera is not always the result, when Bacilli are swallowed and although he continues:) . . . . . "but in the so-called Cholera-diarrhœa we find often a great number of Bacilli—whilst in rapidly developed fatal cases scarcely any evacuations or **any number of Bacilli.**"

Confusion seems to reign supreme.

"Every epidemic seems after a certain duration to lessen in its intensity, not only in the number of cases, but also in the severity of the attack; recoveries become more numerous, even in cases which at first appeared dangerous. There are still sufficient bacilli present, since they propagate and multiply themselves enormously in each case of the disease;—there ought to be more towards the end of the epidemic than there were at the commencement, and yet the epidemic dies out.† This is and has always been the case even at the time when disinfection was unknown, or when it was imperfectly applied.

We are still ignorant, as to the cause of this gradual loss of power of the bacilli, and of their virulence."

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*First ascertain whether a lucifer-match (Swedish or English) or a wax-vesta caused the fire, and then endeavour to prevent the spread of the conflagration.

† The disease has weeded out all persons with the necessary pre-disposition! A proof of the impotence of the bacillus against a natural Immunity.

It is not so difficult, as we shall see further on, to find an explanation of this phenomenon, when the comma-bacillus is disregarded, and our attention directed to the true nature of the disease and to the individual pre-disposition. **This latter found already full acknowledgment in the first cited sentence,** which seems however to have escaped Dr. Dornblüth—the writer—himself.

Dr. Aug. Hirsch very truly remarks in his lecture on Cholera in Magdeburg (26th November, 1892): "Do not let us continue to hunt after the Bacillus, since we do not know where to look for it;—but deprive it of the soil on which it grows and flourishes."—Dr. Hirsch however fails to enlighten us about this "soil."

All endeavours to battle with the disease seem to be concentrated on catching the bacilli, and on making them harmless; but these attempts have proved futile and give little or no promise of success. There can be no doubt that improved drainage and water supply have contributed in London and Berlin to limit the spread of the disease; but this applies only to London and Berlin, and does not protect the rest of mankind.

The means adopted against the spread of the cholera, such as the cordon and the supervision of international intercourse, have proved quite ineffective; and the remarks on this point in Dr. Hirsch's lecture deserve attention:

"To effect such strict exclusion is besides impossible; it develops with the spread of the pestilence into a battle of all against all; and through the check and the disturbance in our social intercourse creates evils, which rather tend to promote the spread of the disease and so in the end do greater harm than Cholera itself."

Cunningham (one of the first English authorities on Cholera) fully agrees with this and "condemns all Land as well as Sea-quarantine. The first cannot be carried out effectively; the latter has proved useless, and both are a serious hindrance to commercial intercourse. As for the medical inspection of the shipping, he considers it in many respects of use; but it can never prevent the spread of cholera."

Professor v. Pettenkofer designates the whole proceeding very appropriately, when he says (p. 4): "The chief question at the

present time seems to be: how to get hold of the bacillus; how to destroy it, or how to prevent its dissemination. This bacillus-hunt is considered as the essential, and by most people as the only effective Prophylaxis."

Not only this pursuit after the bacillus but also the special endeavour to kill the microbe in the human body and make it harmless, has not met with any success.

"We may be able to kill the Comma-bacilli provided we can insure a sufficient quantity of acid to enter the intestines; but we at the same time create conditions which cannot fail to be detrimental to the human body."—(Hueppe, p. 81.)

This opinion is shared amongst many others by Dr. Hugo Meyer (Neue Bonner Zeitung, September 8th, 1892), who thinks that: "No medical art is capable of making the cholera-germ in the human intestine harmless; and all attempts in this direction will do more damage to the patient than to the bacillus."

We are hence fully justified in declaring that the discovery of the Comma-bacillus has not assisted us in advancing our knowledge of the true nature of cholera; and that we have in consequence not made any progress in the prevention and cure of the disease.

"When," as Pettenkofer so pithily remarks: "we have found in an infectious disease the specific disease-producing micro-organism, we are not entitled to assume, that we have also found the means required for conquering the disease."

IV.

b. Favourable Environments ($= y$).

In directing our attention to the second factor: a favourable environment or a temporary local disposition for the outbreak of an Epidemic—we also meet with many contradictions. What appears to be clear and established, will leave us in doubt about the connection between this local disposition and the various phenomena that accompany the outbreak and the disappearance of a Cholera-Epidemic; and opinions differ greatly about the range and the etiological importance of these external local conditions.

Professor v. Pettenkofer lays special stress upon the sinking of the ground-water in a porous soil, and the consequent exposure of a Miasm as a basis for his explanation of this local disposition; but this influence of the sinking of the ground-water has been questioned by other epidemiologists.

Referring to the Hamburg Epidemic (1892), Professor Hüppe declares (p. 8) that: "So far as he could discover, the Epidemic broke out in the various parts of the city and spread afterwards *without regard to the nature of the subsoil*, whether marsh or clay;" and he points to the fact, that a local disposition could only be found in the water supply, to account for the spread of the plague. He cites figures (p. 30) to prove, that the nature of the soil has had no influence on the mortality. "Such striking localisation of the outbreak of the disease in the various streets, it is impossible to explain by the difference of the soil alone" (p. 31).

It is generally assumed, that in low lying parts, such as in river valleys and on alluvial soil—the disease meets with most favourable conditions; yet this is not always the case. "In some Epidemics, as in Vienna 1854, Prague 1866, Paris 1853, Marseilles 1834 . . . the higher parts of the towns were most affected." (Rossbach, p. 102.) And it may well be added: *although the adjacent lower parts, which were subject to the same climatic conditions, offered the same, if not a more favourable factor (so far as this ground-water theory comes in question) for the development and the spread of the disease.*

To show how untrustworthy this theory is, it is only necessary to point to the outbreak of cholera on board-ship (Rossbach pp. 107 to 120); and refer to it for the purpose of illustrating the fact, that Epidemics occur under circumstances, when the ground-water-level or the porosity of the soil do not enter into the question.

Among the circumstances, which may be considered as constituting a favourable local disposition—the supply of drinking water deserves special mention. This "*drink-water-theory*" has been especially insisted upon by Prof. Hüppe in the etiology of the Hamburg Epidemic —as already mentioned. He says (p. 8): "Since all the inhabitants, who were attacked by the disease, could not have drunk the harbour

water, we are forced to look to some other local factor, which would spread its influence over the whole city; and this can only be the water, supplied by the town-water-works, which was taken from the Elbe."

This assumption is however answered by Pettenkofer (p. 31): "When the Cholera broke out in Hamburg it made its appearance simultaneously and with great violence on the island of Wilhelmsburg, which lies outside of Hamburg territory, and to which the Hamburg water-supply does not extend."

Most of the inhabitants of the island obtain their drinking water from wells.

With regard to these factors, which are designated by Rossbach as auxiliary causes of Cholera, it deserves to be pointed out, that they are taken into account in their influence on the Vitality and the Virulence of the Cholera-germ **only, and never on the susceptibility and the individual pre-disposition of the human body**; an important question, to which we shall have to revert further on.

V.

c. Individual Pre-disposition (= *z*).

Among the factors, which are considered as requisite for the outbreak not only of the individual case but also of an epidemic: the Individual Pre-disposition seems to have received the least amount of attention on the part of the Pathologists; although in this field of medical research (as its own special domain) a better insight into the nature of the disease and into the means for combating the same, can be gained, than in the realms of bacteriology and public hygiene.

We meet here at once with the fact, that not all human beings are equally affected by an attack of Cholera; and that, above all, the great mass of the people are immune against the disease.

According to Dr. O'Sullivan's experience in the last Hamburg Epidemic, only 5 per cent. (according to the latest reports only 3 per cent.) of the inhabitants suffered. "It by no means follows that all

persons who swallow the bacilli, even in considerable quantities, necessarily develop cholera. The Hamburg statistics tend to confirm what has been noted in preceding epidemics, namely—that out of any community exposed to the necessary influences, not more on an average than about 5 per cent. contract the disease. This means: that only such a percentage of persons has the requisite pre-disposition, or in other words, afford in their systems a favourable nidus, or breeding ground for the bacilli." He very significantly adds: "What precisely constitutes this pre-disposition to develop cholera is, as yet, a disputed point."

Prof. Hüppe (p. 32) supports this view of comparative Immunity. "The pre-disposition of the people of Central Europe, to develop Cholera, is according to all past Epidemics, not so great, as the predominating Cholera-scare of last year (1892) would lead us to assume; since scarcely 3 per cent. of the inhabitants were attacked, although the conditions for a general infection were the most favourable. Among the attacked, it must be remembered, are included even the slight cases. When we take into account all the various cases from the most severe typical cholera-case down to the slightest, but unmistakable Cholera-diarrhœa, we are forced to conclude, that, with such wide-spread possibility of infection, the number of infected cases, which showed no morbid symptoms, must have been a far greater one."

Rossbach (p. 127) maintains the same opinion: "In every Epidemic a far greater number of people remain exempt from, than are attacked by Cholera, even among those, who live in the same poor and unclean conditions, who eat of the same food, dwell in the same rooms, and come in close contact with the diseased and dying. We are hence forced to assume, that there are human beings, who are insusceptible to Cholera; **who even, when infected, do not develop the disease.**"

To give due importance to this Immunity, it will be necessary to compare the three factors—above enumerated, as requisite for the development of Cholera—in their respective efficiency; for which purpose we will listen to Prof. Hüppe's remarks on that question (pp. 36, 7):

"Infection is composed of a chain of heterogeneous terms" (to use a pseudo-algebraic language) "of which at one place this one, at another

place the other, or at another time a third one is of greater value. We require an Infection-germ, denominated by Pettenkofer as *x*, to start the disease. We require internal conditions, the individual pre-disposition, Pettenkofer's *z*. In theory these two, *x* and *z*, should suffice; but this only happens in the experiment and that only apparently."

It is incomprehensible, why Dr. Hüppe will not accept these two as sufficient for the development of the sporadic-case; what more can be required besides the presence of the cholera-germ *x*, and the individual susceptibility *z*?

"To complete this chain we require in fact still another term to set free the Energy"—that is: to start the disease—; "this factor, which is inserted by Pettenkofer as *y* into the equation, he conceives however too narrow, when he looks upon it as a local and temporary disposition."

"These three factors have been estimated differently at different times and by different Medical Schools. Pathologists, under Virchow's guidance have over-estimated *z*, and under-estimated the other two terms; Pettenkofer's followers have laid too much stress upon *y*, and too little upon *x* and *z*; and the Bacteriologists under Pasteur and Koch have over-valued *x*."

"The Medical School, which considers *z* (the individual pre-disposition) as of first importance, has up till now only one 'Great-Deed' in its favour, namely: Vaccination against Small pox. . . . ."

When pointing to Vaccination against Small-pox as a 'Great Achievement' Dr. Hüppe can certainly not have the intention of recommending, that we should follow in the footsteps of this 'Grand-Deed' and endeavour to develop an Immunity against Cholera by the inoculation of a Cholera-virus . . . .? He expresses himself decidedly against such a procedure. But when he says (p. 38): "To combat the individual pre-disposition, it is self-evident that not much could be done" . . . he only admits in these simple words the helpless position, which physicians have taken up in relation to this individual susceptibility.

Surely it cannot redound to the honour of the Faculty, that it has been seriously proposed to employ inoculation against cholera, much

less that actual experiments have been made in this direction—before a clear insight has been gained into the true nature of the disease and into any similarity and dissimilarity of Cholera as compared with Variola—so far as it relates to the inoculation of a virus ;—and that the suggestions of Dr. Haffkine's have been listened to, and been met by an expression of doubt only and not of protest. It seems preposterous: to prevent Cholera by submitting all the people liable to the disease—that is the human race—to an inoculation, when it is considered, that in most violent epidemics only from five to seven per cent. (in Hamburg in 1892 only three per cent.) of the inhabitants of the affected district, have suffered from the disease in all its varying degree. One might pale before a science, which proposes to apply such means to 100 persons, that three of them may be saved from an attack of the disease, and half of these from death; especially so, since a second inoculation is deemed necessary to deprive the first of its life-endangering character.

In an article on "Vaccination against Cholera"—in the *Fortnightly Review*, March, 1893—Dr. Haffkine relates his researches and experiments on this subject, and states :

"The wound of which I have spoken" (as the result of the first inoculation) "is absolutely horrifying to look at and in all probability extremely painful. Moreover, although of itself, it does not present any danger to the health of the individual inoculated, it exposes him to all the complications inseparable from open wounds ; such as erysipelas, gangrenous suppuration, &c."

"The point was to discover a new vaccine, which would protect the organism against the violent local re-action, and this could manifestly only be a modified culture of the microbe," . . . hence . . . "two successive vaccinations are necessary."

It needs but the legal enforcement of this "horrifying" double inoculation, to make such "Scientists" (who appear to have lost all reason) happy; if however Cholera will be prevented . . . ?

VI.

With the object of placing the relative importance of the individual pre-disposition—as compared with the two other factors for the development of Cholera—in its proper light, we will assume that

x and y, i.e. the Disease-germ and the local disposition are present in full force and under most favourable conditions for the outbreak of the disease;—but even then only five (in dirty Srinagar, under conditions, which certainly could not be more propitious—only seven) out of 100 people are attacked.

Here the question arises: has the Cholera passed by these ninety-five non-affected, in consequence of which they have escaped through some lucky accident; or have the bacilli, which were swallowed by these fortunate beings, proved ineffective and been perhaps killed in their passage through the human body?

If every attack of Cholera proved absolutely fatal our conclusions would, no doubt, be in favour of the first supposition; since however some of the affected suffer only a slight attack of diarrhœa, although their dejecta contained the Cholera-bacillus; and although these bacilli, which were found in the fæces of such slight cases, have been often the cause of serious extensive outbreaks:—we cannot entertain any doubt about it, that the greater number of the lucky ninety-five, have escaped the disease through a fortunate Immunity.

This is fully confirmed by Dr. B. Hawkins (p. 106), who states, in his account of the Epidemic in Russia in 1831: "During the prevalence of the epidemic, there was scarcely a single inhabitant of the city of Orenburg, who had not symptons of disordered digestion. These trifling symptoms of disease were usually ascribed to errors in diet. But to me it appears, that their cause was a general invasion of the system by Cholera, which however was prevented from developing itself in its perfect character, by a regular manner of living and other circumstances of the kind."

In other words: in consequence of an Immunity against the Cholera-poison.

The consideration of such facts should undoubtedly decide us, in giving to the individual immunity the first place, as deserving of our special inquiry; the more so, since in such an inquiry we should find a surer guide towards a precise knowledge of the true nature of Cholera, and to the proper and most effective means for the prevention of the disease.

In the most violent epidemics over ninety per cent. of a population are already protected through a natural constitutional immunity; let us endeavour by the discovery of the nature of this immunity to protect the other ten per cent. and save half of these from an untimely death.

VII.

The numerous bacteriological experiments—undertaken for the purpose of determining the Vitality and the Virulence of the Cholera-bacillus under the varying conditions, which are generally designated as local and temporary dispositions:—have not advanced us one step towards a true explanation of the nature of Cholera, or given us the means for preventing the disease with any certainty; and the energy, which has thus been fruitlessly (so far as the main object is concerned) expended, would certainly have been better applied to an investigation of that state of the human system, on which the Immunity from Cholera depends.

How far the virulence of the Comma-bacillus and the whole bacteriological science is mocked and derided by the attested facts in relation to the outbreak and spread of the disease, may be inferred from an observation of Dr. Hüppe's (pp. 63, 4).

"For the development of a severe case it requires undoubtedly a further(!) disposition in relation to the already absorbed poison. This view is forced upon us through clinical observations on human beings as well as through experiments on animals. When once infection has taken place, and multiplications of the bacillus has commenced in the intestines—then all influence of a local disposition comes too late, and only a fortunate individual constitution in relation to the poison can save, and prevent a slight case from assuming a severe form of the disease. Where no individual pre-disposition exists, in that case the absorption of the poison, even with most favourable conditions in the environment (local disposition) will not produce

Cholera:—as was proved by the child, which during the Hamburg Epidemic—**therefore under unquestionably most favourable conditions for the development of Cholera—swallowed the dejecta of the father** (mistaking it for gruel) **without suffering in the slightest degree.**"

Everything, hence, points to the fact, that the individual pre-disposition is the chief factor in the production of Cholera;—that local and temporary conditions are powerless;—that even the most virulent Cholera-poison proves ineffective against the insusceptible human body; and that the severity of a case depends upon the degree of susceptibility. Why then all the researches in the fields of Bacteriology (the poison x) and the fruitless inquiries about the temporary and local conditions (the y), when everything depends upon the individual predisposition (the z)?

It must be evident from the above inquiries, that we shall have to look to the Immunity of the human body against Cholera as the principal means to be employed for the prevention of the disease, and that hence all our energies should be concentrated on the discovery of the nature and character of this Immunity.

It has already been pointed out, that this Immunity is not absolute, not positive; but shows itself in varying degrees. Most instructive is, in this respect the Epidemic in Marseille in 1884, about which Dr. Mireur (p. 32) reports, that the disease "donne lieu, dans la plupart des cas, aux manifestations les plus diverses et procède d'une manière absolument différente suivant les sujets qu'elle atteint."

"Tantôt précédé de la diarrhée prémonitoire, le choléra actuel ne se développe qu'après plusieurs jours de malaises bien accusés; d'autres fois, il frappe à l'improviste, au milieu de sommeil, par exemple, en pleine santé apparente; — ici, il provoque des vomissements abondants, des déjections riziformes, des crampes extrêmement douloureuses; là, aucune de ses manifestations;—chez celui-ci, algidité complète, cyanose, suppression des urines, voix éteinte, affaissement de la région orbitaire; chez celui-là, rien de plus qu'une constriction épouvantable de la poitrine; — ici encore, apparence d'une maladie des-plus graves, désespérée même, qui guérit quelquefois; là, au contraire, on dirait une affection presque légère

qui se complique soudainement et tue en moins d'une heure; — chez les uns, developpement lent et progressif; chez les autres rapidité foudroyante; — dans un cas, rétablissement complet en vingt-quatre ou quarante-huit heures; dans un autre transformation en fièvre typhoïde, souvent mortelle."

Such different manifestations of the disease—even the different symptoms of the different cases—can be explained only by the difference in the constitutions of the attacked; and cannot be referred, as has been attempted, to the difference in the quantity of the swallowed and absorbed Cholera-poison, or the greater or lesser virulence of the latter. For, as Rossbach declares (p. 144) "the evacuations of even the lightest cases of Cholera-diarrhœa are as much the conveyers of the infectious poison as those of most severe fatal cases of the disease;" and it is well known (p. 85) "that it is not from the living or dead body of a Cholera-sufferer only, that the disease germ can emanate; but that infection can spread from even the slightest case of Cholera-diarrhœa, as from the most fatal;" . . . . for the simple reason, that the severity of the attack and the fatal issue depend upon the individual pre-disposition of the patient.

This is confirmed by Dr. Mireur in his report upon the Marseilles Epidemic of 1884, where he says (p. 15): "Nous pensons que les individus eux mêmes, selon leur constitution et les dispositions du moment offrent une réceptivité plus ou moins grande au principe infectueux, parce qu'ils constituent des milieux plus ou moins favorables au developpement de ce principe, c'est a dire du choléra lui-même."

And lastly:

"The Cholera-bacilli, according to Professor Virchow, are unquestionably necessary for the development of the disease; whilst, however, they find in one body the required favourable conditions, they pass through the system of another, without doing any harm."

VIII.

With the object now of gaining some insight into the nature of this individual pre-disposition (or what may be called its reciprocal: the immunity) it is necessary to inquire into the nature of cholera: to learn

in what part or system of the human body (whether the blood or the nervous system) the disease endangers life; and secondly to investigate the other external factors in their influence on, and their connections with that part or that system of the organism just referred to.

It will be our first task here to pay attention to those symptoms of the disease, which specially indicate the fatal character of Cholera. Of these symptoms the most conspicuous are: The abnormal loss of water, and as a consequence: the thickening and viscidity of the blood and the resulting sluggishness if not the entire stagnation of the circulation; cessation of the material changes in the system accompanied by a lowering of the temperature; mostly complete suppression of renal secretion with an accumulation of effete nitrogenous compounds in the blood and the tissues; and lastly the assumed direct toxic action of a poison, which "has been formed in the intestines by the secretions of Koch's Comma-bacillus and been absorbed into the circulation."

In addition to this poison, the product of the Comma-bacillus, Rossbach (p. 160) surmises that:— ". . . . possibly another poisonous substance is formed in the blood, which latter has undergone essential changes (Dissolution of the Hæmoglobin)." A surmise, which seems to have greater significance in relation to these essential changes of the blood, than to the formation of the hypothetical poison—as will appear further on.

In the estimation of these symptoms of the disease—in so far as they endanger the life of the patient and "are still hypothetical in their nature" —there exists great diversity of opinion amongst physicians and pathologists—for the simple reason that it is next to impossible to make the theories advanced, harmonise with the observed facts.

"It is well known, that frequent attempts are made to deny, that Water-abstraction from the system is the chief agent in the production of the cholera-symptoms, and to ascribe these latter to less known chemical poisons. But we cannot agree to surrender the old prevalent views, until more valid proofs for the new ones, have been advanced." (Rossbach p. 161).

We find hence the Water-abstraction or Water-drainage-theory opposed by the Poison-theory.

Let us first direct our inquiry to the Drainage-theory, and especially to those cases, in which the loss of blood-serum takes place to the

fullest extent; and we shall discover at once, that this drainage of the system cannot possibly be the cause of the fatal issue of a Cholera attack.

Rossbach himself, although fully supporting the Drainage-theory, states facts and offers remarks upon them, which raise in us the greatest doubt regarding that theory. He says (p. 183): "However easy it may appear, to ascribe the greater part of the symptoms in most Cholera-cases to the loss of water and a consequent reduction in the quantity of the blood, and its thickening—we dare not lose sight of the fact, that in many cases the symptoms do not adapt themselves to such a theory. In numerous cases it can be observed that the great weakness of the heart, the icy temperature of the skin, the cyanosis and the extraordinary sudden fatal termination, cannot be explained by the few evacuations and the insignificant quantity of fluid, discovered in the intestines after death; it was impossible to connect the first-mentioned symptoms with any considerable abstraction of water from the blood or the body generally. In contra-distinction to this, it must be mentioned, that a sufficient number of cases has come to our notice, in which the evacuations were most abundant and which nevertheless never reached the critical algide (cold) stage. Romberg and others have thought themselves justified to conclude: that the diagnosis was more favourable with massive than with scanty evacuations. Griesinger calls attention to the fact: how in Cholera nostras, notwithstanding that the evacuations take place in such large quantities, as could not possibly be exceeded in the Asiatic Cholera—yet no algide fatal stage ever occurs. He hence entertains the opinion that an additional cause for the great weakness of the heart must be sought in the intestines, acting through the intervention of the nerves."

Certain it is: that loss of water from the blood or the body generally, cannot either directly or indirectly, be the cause of the fatal issue of a Cholera-attack, and this finds confirmation, ever since observations have been made on the disease, in those numerous cases, in which death resulted without purging and without vomiting.

It deserves to be mentioned, what has been stated in relation to this question by Prof. Dr. H. von Ziemssen (p. 14). "Although the greatest

disturbances in the system will find an explanation in the enormous loss of water from the blood through the transfusions into the intestines—yet the danger does not depend alone upon this, **but upon something else.** If loss of water alone could decide the fatal issue, then a timely and regular injection should remove the danger, which however, according to Italian experiences, is not the case. It would be impossible to find an explanation of those cases, in which the most rapid fatal issue occurs with relatively scanty transfusions, in the so-called Cholera-sicca (dry Cholera); and the well authenticated fact—that: not those cases of abundant, but those of scanty transfusions are the most fatal — would be incomprehensible. **We are hence forced to assume another factor, which is so destructive to the human organism.**"

All attempts to explain the phenomena end in doubt and in reference to: "Something else" — "another Moment"— "another Factor," and leave us without the faintest indication, how this Mystery is to be solved.

IX.

Having failed in discovering the cause of the fatal issue of a Cholera-attack in the loss of water from the blood, let us now investigate the poison-theory, for which its advocates believe to possess the necessary proof in those fatal cases, which terminate suddenly. The language, however, in which such opinion is advanced conveys the idea that the defenders of that theory are not quite confident about their case.

Cantani (p. 7), for example, expresses himself on this point as follows:

"During the Cholera-Epidemic in Naples in 1884, a great many patients died, whilst their evacuations were still coloured; probably: because the blood-poisoning killed, before the loss of water had assumed any serious proportions."

By expressing himself thus, he evidently means to indicate, that generally the cause of death must be ascribed to the loss of

water; that nevertheless in many cases the fatal issue of the disease is due to poison. And yet immediately following he declares (p. 8): "It is unquestionable that in the cold-asphyctic-cyanotic stage of the disease—heat is the most effective stimulant to the patient; and what a hot bath (which, with a viscid, thickened state of the blood, rather tends to increase the paralysis of the heart), cannot effect, may be produced by an injection of hot water into the vascular system; the result of which, one must have seen, to form some appreciative conception of its importance."

In accordance with this statement (read in connection with his first cited opinion), we can employ Heat as an antidote against Poison, which is very questionable.

Dr. Robt. Koch also: "cannot deduce the complex of symptoms of a true cholera-case any longer from the loss of water and the thickening of the blood—but looks upon it as the result of a chemical poison produced by the Comma-bacillus." "Against this poison-theory Samuel has raised the objection, that the intestines of a Cholera-patient are incapacitated from absorbing anything; that beyond the assumed poisonous effect on the heart, every other indication of a toxic action is wanting . . . . and above all, that in the developed asphyctic stage, it is possible to restore the circulation successfully by means of a powerful water-injection into the blood or into the subcutaneous tissues." (Rossbach, pp. 184, 5.)

The poison-theory finds an ardent supporter in Prof. Hüppe (pp. 70, 1.), who bases his reasoning upon the renal affections, which "can find an explanation only in the simultaneous specific action of the poison upon the kidneys. . . . . It is just in the acute cases in which we find a typical picture of a severe poisoning. . . ."

"The indications of a feeble heart, which may be explained partly" (!) "by a direct poisoning of the heart's muscles . . . . further the stagnation of the blood, which may be referred to a poisoning of Vaso-motor centres—all these are fully developed before the loss of water can be taken into account."

And he sums up his remarks by saying:—"The most important result of experiments and of my personal investigation with Cholera-patients hence, is: that, under favourable conditions, as they exist in he intestines to furnish the pabulum and the oxygen—the Comma-

bacilli multiply and produce a specific peptonic poison, which is the originator of the chief symptoms of cholera."

And yet — all these Poison-theories have been confuted and proved to be false.

So mentions Rossbach about the Anuria (p. 175): "That the Cholera-kidney must not be considered as an acute Nephritis, is shown by **the extraordinary sudden disappearance of all symptoms and by the possibility of an immediate restitution of the diseased kidney in its full activity, when, with the cessation of the Cholera-symptoms, the blood circulation has been completely restored.**"

It is certainly out of the question here, to look upon these renal symptoms as the effect of a poison; since disorganisation in the tissues would remain behind, which could not disappear (if at all) so suddenly.

The same reasoning applies to the heart, which is—it is assumed—paralysed through the toxic effect of the cholera-poison.

"The heart is at first—as in the case of a rapid bleeding to death—subject to violent painful palpitations, after which its beats become weaker and weaker; . . . ."

Be it noted: as in the case of a rapid bleeding to death—therefore not of a poisoning ". . . . and this weakness is a further cause of the stoppage of the circulation. The dead body affords no indication of any structural alteration of the heart." (Rossbach, p. 169.)

And, let it be added, what Cantani has already told us: "the direct injection of hot water enables the heart to regain its normal 'activity;'"—which certainly would not be the case had it ceased to act through the effect of poison.

Cantani himself, is fully conscious of the untenability of the poison-theory, and only adopts it, in cases in which the fatal issue cannot be explained by the loss of water from the system; for he says (p. 4):

"If we do not wish to expose ourselves to bitter disappointments, we must, in the practical treatment of Cholera-patients, adhere to the fact that during every epidemic we meet with cases, in which the danger has to be looked for in the Cholera-intoxication" (poisoning); "others in the thickening and viscidity of the blood;

and still others in which these two mortal causes balance each other."

How little confidence such conclusions, such logical indecision must inspire, is sufficiently evidenced by the above inquiry into these two theories and needs no further comment; but it leaves in us a feeling of doubt about our ever gaining a true insight into the real Nature of Cholera.

X.

The question arises now: Has the disease its origin in the intestines and are the symptoms, which are observed in the blood, caused by an absorption into the circulation of either the bacillus itself, or of the poison produced by the mircrobe;—or: does the first attack of a Cholera case take place in the blood, develop in it a poison or abnormal substance, against which the blood reacts and which it endeavours to expel by way of the intestines?

Rossbach, to whom we are indebted for a very able treatise on the pathology of Cholera, remarks in relation to the above question (pp. 164,5):

"The behaviour of the intestines with regard to their capabilites of absorption in a Cholera-patient is not so well ascertained as might be desirable—in consequence of the too complex nature of the question. Yet, for two reasons we may conclude with great probability, that in a true cholera case the absorption has virtually ceased; first: from the enormous quantity of water, which is constantly secreted and retained in the intestines; and next: that the internal administration of violent poisons, such as Atropine, and Strychnine in a Cholera-patient has no discernible effect;—whereas by a direct injection into the blood under the same condition of the patient such effect can be observed."

"Griesinger raises the question: where we are to look for the true origin of the watery secretions; whether on the surface of the mucous membrane of the intestines, that is from without; or from the blood—from the interior of the vessels from which the poison acts on the nerves of the intestinal glands. The first view has in various ways received greater support; for example in the adoption of the theory,

that the cause of Cholera must be considered as an irritating poison or, according to Pacini, as a living animal which attacks the mucous membrane of the intestinal canal. But we are justified in giving preference to the second view, and assume, that the cholera-poison, similarly as Arsenic and Tartar-emetic, &c., &c., acts from the blood."

"Griesinger thinks, that the presence of the Cholera-poison in the blood, is incontestably proved by the fact, that a fœtus can have an attack of the disease; which fact has been confirmed by many other observers" . . . . and is reported by Rossbach (p. 126), who declares that: . . . . "the dead, expelled offsprings of aborting Cholera-patients are said to show all the external signs of death from Cholera."

That the chief—the mortal symptoms, as the effect of the Cholera-poison, are to be looked for in the blood, is also confirmed by Mireur (p. 31):

"These experiments . . . . appear to us, as leading to the following conclusions—namely: that the contents of the stomach and of the intestines, and even the most distinct rice-water dejections, are absolutely non-infectious; that this is the same with the blood, when taken from the patient during the re-action stage, and that it is only in the algide (the fatal) period of the attack, that the blood possesses any power of causing infection."

And Koch himself "since he has found his Comma-bacillus only in the intestines and not in the blood or any other organ, does not venture to explain the cause of death in Cholera through the vegetation and propagation of the bacillus in the intestines; and hence reverts to the supposition, that the morbid and mortal effect can only be the result of a poison produced by or through the bacilli." (Rossbach, p. 65.)

Prof. Dr. Robert Koch, the discoverer of the Comma-bacillus admits thereby: that the Cholera-poison has its sphere of destructive action in the blood.

All these declarations lead to the conclusion, that we have to search in the blood for the cause of the fatal issue of a Cholera case, with the object of discovering the nature of the individual Immunity; and if we now extend our inquiry to the blood in the healthy human being, in the Cholera patient and lastly in the dead body of a fatal Cholera case, we shall find the above fully confirmed.

XI.

It is self-evident, that in so complicated an organism as the human body, one part of it cannot suffer, without the other parts becoming at the same time more or less involved, and responding in sympathy. When however the chief symptoms, which are characteristic of Cholera, are closely investigated, it will appear beyond doubt, that this disease has its special seat in the blood; that it endangers the life of the sufferer through the destruction of the blood; that this destruction is the real cause of death and that the symptoms, as far as they manifest themselves in the nervous system, are but the sequence of the blood's failure in performing its physiological functions.

When the blood has lost the power of absorbing the oxygen of the atmosphere, and of distributing it in the various parts of the body—by which process animal heat is produced and maintained, and upon which the life of the nervous system, that is: human life itself depends—the following symptoms are the result: difficulty in breathing (dyspnœa); a feeling of suffocation arises; asphyxia sets in; coldness spreads gradually over the whole body; the skin turns blue (cyanosis); whilst the sufferer, with full consciousness, finds life ebbing away until death ends the scene.

It cannot be doubted any longer, after the many declarations of Physicians and Pathologists, who have closely studied the disease, that the essential alteration of the blood, is the chief factor and the dangerous moment in the development of the individual cholera-case.

Dr. Hawkins's (p. 62) remarks point to this, when he says: "A frequent variety, the worst of all, is that which is noted for the very slight commotion in the system, in which there is no vomiting, hardly any purging, perhaps only one or two loose stools, no perceptible spasms, no pain of any kind; a mortal coldness with arrest of the circulation **comes on from the beginning** and the patient dies without a struggle."

Dr. Milroy (Reynold's System of Medicine I. p. 162) states that: "at Teheran, in 1846, those, who were attacked, dropped down suddenly in a state of lethargy and died at the end of two or three hours without

convulsions or vomiting, but from a complete stagnation of blood."

On the question of timely sequence in the complex of symptoms, in so far as it points to the blood as the original seat of the disease, Dr. Hartley Kennedy (p. 40) (who has had an extensive practice in watching the disease in India) says:

"It is more than probable, however, that these" (Diarrhœa and Vomiting) "are merely the **first perceptible** symptoms; for it would appear that a great change **has already** taken place in the circulatory system, and that the action of the heart itself has been greatly diminished before they occur."

Nothing seems to point so much to the seat of the origin of the disease as the early sinking of the body's temperature "which is so characteristic of Cholera, that the critical stage—the stadium algidum has been named after it. Whoever has the opportunity to watch a patient immediately after infection, before the Cholera-symptoms make their appearance, he will already find **a sinking of the body's temperature as first indication of an otherwise latent infection.** This fact which was ascertained by Friedländer and Wunderlich may serve as a proof, that the lower temperature of the skin, is by no means the result of the evacuations. This sinking of the temperature generally accompanies the reduction of the quantity of blood" (but how without evacuations?) "**the sluggishness and gradual arrest of the circulation** and the general cyanosis; yet there are cases in which an icy coldness has been observed in the extremities with a still powerful pulse, which can be explained by a deficient production of animal heat, *i.e.* low" (diminished) "oxydation-process in the tissues of the whole body."

In other words: all phenomena indicate that the blood has lost its physiological function of absorbing oxygen and giving it off to the various tissues; in consequence of which: weakness of the heart,—stagnation of the circulation,—lowering of temperature,—cessation in the oxygena-

tion and the change of matter, — and arrest in the secretion of the kidneys, with other morbid symptoms are the result.

We shall find this fully confirmed, if we now direct our investigations to the blood-corpuscles as they present themselves in the blood of Cholera-patients.

XII.

Already in the earlier attempts to define the nature of Cholera, attention was specially directed to the condition of the blood. In the report of Drs. Russell and Barry in a circular of the General Board of Health (Dec. 1831) it is stated that:

"The blood ceases to circulate; its physical properties are altered; .... the secretions are all arrested, and animal heat is no longer produced."

This general description of the diseased state of the blood finds full and special confirmation in the

"Recherches scientifiques de la Commission nommé par la Société Nationale de Médecine de Marseille (Faites à Marseille pendant l'Epidemic de 1884)." (Mireur, pp. 25, 26.)

The Committee had for its special object:

"To study the state of the blood in Cholera-patients."

"The researches of the Committee have led to most interesting results. According to their investigations it appears in fact now established, that Cholera-blood, in the algide period, loses its normal properties and becomes more or less fluid according to the severity of the case; whilst the blood corpuscles become soft, and gradually lose their natural form and even disintegrate."

"One of the alterations which appeared to us to have a preponderating importance, because of its constancy— is that, which refers to the blood globules. This alteration is of a peculiar nature, namely, that it does not occur simultaneously in all the

globules*; on the contrary, one can see, in cases which proved rapidly fatal, globules which are completely altered by the side of globules perfectly healthy, and affecting these latter in their tendency to form rolls of coin" (pile d'écus).

"The alteration consists in the softening of the corpuscles" (or globules) "and their consequent deformity through the mutual pressure" (with adjacent globules); "their agglutination to a spherical mass, is the greater, as the period" (of the disease) "is advanced. If now a current" (of the blood to be investigated) "is produced on a plate of observation, one can see the diseased" (and deceased) "globules run like fluid lava or like melted pitch between masses of more solid globules; and their glutenous adhesion is such, that through the mechanical effect of the current, one sees the diseased globules elongate themselves, assume the form of an olive, almost cylindric; stretch themselves short of disruption—when, if the alteration is not too far advanced, the globules return to their original form by virtue of their elasticity;—but we have found that, in very severe cases, the globules had lost this property" (this power) "and retained the olive-form even in their isolated state; and became convinced, that it had lost all power of adherence to the neighbouring globules, even by filaments of fibrin. If during the microscopic examination artificial serum is added, one soon observes the greater part of the globules resume their individuality" (independence) "their normal form and their tendency to unite into 'rolls of coin'; but in cases in which the globules are most changed "(are in fact killed)" the separation does not occur."

"We have found this alteration of the blood in all cases. We are hence inclined to regard it as characteristic, as a pathognomonic lesion of Cholera."

Dr. Mireur cites (p. 44) also the results of Messrs. Nicati and Rietsch's investigations, from which the following extract bears upon this question: "In Cholera, during the algid period, one finds always a certain number of globules deprived of their hæmoglobin; these are true skeletons of globules, scarcely recognizable in their irregularly pleated envelope."

In relation to this altered condition of the blood Rossbach (p. 121) remarks, that: "at the critical period of the disease the blood has a

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* See page 42.

syrup-like consistency; coagulates to a homogeneous gelatinous mass, from which scarcely any serum separates, and has a dark black colour, although when shaken with atmospheric air it becomes slightly lighter. The proportion of water has been stated, when compared with a healthy normal blood, as reduced by 10 to 13 per cent. Carl Schmidt found, that in normal blood 1000 gr. blood-serum contained 908·8 gr. water, whereas in the same quantity of blood taken from a corpse of a patient, who died in the most critical period of the attack, 900·8 gr. of water were found, so that in this case there was only a loss of 8 gr. out of 1000 gr. serum.

It is hence contrary to all facts to declare the stagnation of the circulation to be caused by the loss of water; hence this stagnation must be attributed to another alteration in the condition of the diseased blood, for which the report on the Marseilles Epidemic furnishes us with the necessary proof.

Rossbach (p. 172) also, although not so distinctly, refers to this altered condition of the blood. He says: Whether this exceedingly great alteration in the blood is accompanied by a change in its chemical properties, such as the behaviour of the red blood-corpuscles to oxygen, etc., is not known, but very probable. To the above-named causes of a difficulty in the supply of oxygen to the system must be added the further factor, that the blood-corpuscles have lost the greater part of their power of absorbing oxygen and of giving it off to the tissues.

XIII.

When closely considering these various statements about the condition of the blood in Cholera, we are naturally induced to ask the question: whether such condition of the blood is not in itself sufficient, or whether it is necessary to assume a poisoning effect on the nervous system, for the purpose of finding an explanation for all the chief symptoms and the fatal issue of the disease. In other words:

Is not the disease in all its phases fully accounted for by the effect of the Cholera-poison on the blood-corpuscles: destroying and killing these in larger or smaller quantity; and are the morbid phenomena observed in the nervous-

system not the result of such a destruction and deterioration of the blood-corpuscles?

In face of the absolute dependency of the vitality of the nervous system on the presence of oxygen in the blood, it is not difficult to explain these neuro-pathic disturbances; and in the enumeration and description of these latter, we can already discover an indication of the argument in favour of the above-named theory of Cholera.

The manifestations of these nervous conditions are the following: soon after the commencement of . . . . the feebleness of the heart—anxiety, swooning and prostration make their appearance, and the latter can even assume the character of fainting. The patients lie quiet and listless, although not sleeping; but retain consciousness for a long time. Only with the height of the attack begin signs of unconsciousness, mental dulness, inclination to doze, difficulties of hearing and defective sight; delirium is seldom met with. (Rossbach, p. 177.)

Mireur supports the above in his remarks under "Considérations Générales" (p. 153):

La lucidité intellectuelle est la règle chez les cholériques; elle ne s'éteint, dans la plupart des cas, qu'avec la vie ou du moins peu d'instants avant la mort.

For reasons above stated, we can well comprehend, that the spinal cord also refuses to fulfil its function as a consequence of the stagnation of the blood circulation

The spinal marrow, although it shows no anatomical lesions, still suffers in a number of its functions, especially its powers of reflex-action. (Rossbach, p. 177.)

The same authority concedes, that the muscular spasms need not be looked upon as the results of nerve-poisoning, when he says: Muscular spasms, which are in many epidemics of extraordinary frequency, are in others very seldom met with, and are most probably not dependent upon central disturbances; but are the manifestations of the sudden alterations in the blood-circulation and of the sudden diminution and thickening of the blood in the muscle; in like manner one can observe painful contractions in the case of embolism in the artery of an extremity. These spasms coincide with . . . . the weakness of the heart. (p. 178.)

Hermann (Grundriss der Physiologie, 3. ed. p. 163) asserts: that want of oxygen in the blood causes spasms in the various muscles of the body; hence, these spasms are not the result of poison —but simply of a deficient supply of oxygen to the blood.

In a similar way can we connect the great weakness of the heart with want of oxygen in the blood; as altogether in fact, the dynamic factor for the blood circulation has to be looked for in the presence of oxygen. As already mentioned above, Samuel (Rossbach, p. 185,) has pointed out in relation to the poison-theory: that besides the assumed action of the cholera-poison on the heart, every other manifestation of poisoning is wanting; that with a timely check of the evacuations by the administration of opium, as also with the cessation of the enteric-asphyctic stage—circumstances which would favour the absorption of the assumed heart's poison—not the slightest trace of the heart's paralysis will manifest itself; . . . . and above all, that it is possible, during the most critical period in the asphyctic stage, to restore the circulation by a strong injection of water into the blood direct, or into the subcutaneous tissues.

It is hence not illogical to refer the chief phenomenon in the development of the disease—namely the great weakness of the heart—to a deficiency of oxygen in the blood; which moreover has been experimentally confirmed by Aubert (p. 365).

The oxygen of the atmosphere has a direct influence on the duration of the heart's action; whereas carbonic acid reduces it. **Deficiency of oxygen causes apparent death of the heart**—and let us add, is hence the cause of all the subsequent symptoms: stagnation of the circulation; lowering of the body's temperature owing to a diminished oxygenation of the tissues; feeling of suffocation; reduction, if not entire cessation of renal secretion, etc.

If Griesinger surmises, that the weakness of the heart must have, besides, another cause, probably originating in the intestines and acting through the medium of the nerves,—he seems to overlook the physiological alteration in the blood, which must unquestionably be considered as the principal symptom of the disease, in consequence of which the blood has lost, through want of oxygen, its exciting influence upon the nerve centres of the heart.

Although a doubt is entertained by many pathologists, about experiments on animals being used as a guide for arriving at conclusions in relation to the human body; still, the following remarks deserve a place here (Rossbach, p. 67): In the case of guinea-pigs—a subcutaneous injection of the Cholera-poison (as prepared by Nicati and Rietsch) had the following effect: . . . . *(b)* after a fatal dose . . . . a gradual sinking of the temperature; . . . . incisions into the skin produced no blood; perfect immobility; electric irritation of the muscles still result in spasms and reflex action still exists. Death takes place in about three hours. **Dissection shows no inflammation in the intestines.**

In the case of mice, (*b*) after fatal doses: sudden perfect immobility whilst sensibility remains; great tendency to sleep followed by muscular spasms of the head; . . . . rapid sinking of the temperature down to 32° C. (89° F.). With still greater doses, death supervenes in from three to five minutes with the above phenomena and retention of reflex action until the last.

And lastly—let us study the phenomena as manifested in the dead human body after an attack of the disease which had a rapid fatal issue, as reported by Rossbach (p. 153):

For several—up to nine—hours after death fibrillous and powerful irregular spasms could be observed in separate as also in whole groups of muscles of the upper extremities—less frequently of the trunk or lower extremities—which spasms appeared quite spontaneously; but they could also be produced by irritation of the superposed skin or by mechanical pressure upon the muscle. The arm would bend, the fingers would move as in pianoforte playing; and Barlow will have observed, that the mouth opened and shut, so that the spectators, noticing this, considered it as a sign of reawakening life.

It is impossible to interpret all these phenomena otherwise than: that the Nervous-system, as the Carrier of Life, has been deprived of its food:—the oxygen, upon the supply of which its activity depends; and that thus, in the above movements, it still **manifests the last remains of the ebbing vitality, after death has already overtaken the blood, from which it drew its nourishment.**

In fact, the whole picture of death from Cholera gives unmistakable evidence: that the **chief-moment** for the extinction of life can be found in the gradual refusal of the blood to perform its functions, and in the consequent stagnation of the circulation; every mortal symptom points to it, that the Cholera-poison has worked its mischief in the blood, especially in the blood-corpuscles; and that hence in a strong wholesome blood we have to look or the power to resist the poison, *i.e.* **for the Individual Immunity against Cholera.**

XIV.

To obtain, now, a more definite idea about the nature of this Immunity of the human body, in other words of the Cholera-resisting-power of the human blood—it is expedient to gain some information about the blood and the blood-corpuscles; and to inquire: under what circumstances and through which agencies and influences the blood is so altered, as to make it susceptible for the attack of the Cholera-virus; and on the other hand: how and by what means the resistance—this Immunity from attack, can be developed and strengthened.

It is not out of place here to call attention to a fact, which must appear as most singular and inexplicable, that namely: at every investigation of the conditions, under which the disease can and does develop and spread—such as for example the high atmospheric temperature, the dryness or humidity of the air, the rainfall, the state of the "ground-water," &c., &c. .... these conditions are considered only in relation to the propagation, the vitality and the virulence of the Cholera-bacillus and **never to the individual Predisposition of the human body.**

Let us but note what Rossbach says (p. 106): On the temporary Disposition for Cholera and on the influence, which the climate, the seasons and the temperature exercise on Cholera-epidemics.

"When extending our inquiry over long periods we can discover a certain connection, between the spread, the intensity and the extinction

of a Cholera-epidemic, and the time of the year, the climate and the prevailing temperature; always however only so far as all these factors promote or check the development and the growth of the Cholera-germ."

It was never given one moment's thought to investigate the influence, which these factors could have on the individual human susceptibility; hence the many contradictions we meet with in the attempts of explaining the various phenomena in connection with epidemic Cholera.

"On the whole it is found, that Epidemics die out in the temperate and cooler climates on the approach of winter; since during this period the Cholera-germ, existing in the ground loses its power of propagation in consequence of the low temperature" .... yet .... "there have been, although not frequently, violent winter-epidemics, as for example in the winter of 1829 in Orenburg (Russia) at—30° C. (22° F. below Zero); 1830-1 in Moscow at—30° C.; 1831-2 in Prague; 1848 in Halle and Breslau; 1852-3 in St. Petersburgh; 1855-6 in Vienna. In Bergen (Norway) Cholera broke out in January and continued during a temperature which caused Mercury to freeze."

In short: Cholera Epidemics die out with the approach of cold weather—because the Cholera-germ loses its propagating-powers; and yet an epidemic breaks out and lasts during a temperature, in which mercury freezes.

Always Contradiction!

As the result of many observations on the influences which temporary and local circumstances exercise on the outbreak and spread of Cholera, it has been ascertained that Heat and Moisture are two factors, which affect the development of an epidemic.

In the investigation of the influence, which these two factors exert, we shall direct our attention to the human body, and especially to the blood and the blood-corpuscles—as a means of gaining an insight into the human susceptibility for the Cholera-poison; and we shall then endeavour to bring the various phenomena, connected with an epidemic in harmony with the result of our inquiry about the theory of the individual predisposition.

The immediate question before us is then: What is the effect or influence, either direct or indirect of Heat and Moisture (= Water) on the blood generally and on the blood-corpuscles in particular?

With regard to a high temperature, it is well known, that its direct effect on the blood is imperceptible; its influence is more indirect, about which we shall treat further on.

The effect of Water on the blood and especially the blood-corpuscles is however most immediate. All Physiologists will inform us, that through the addition of a sufficient quantity of water, the blood-corpuscles are destroyed; and water offers a convenient agent for the dissolution of the blood-corpuscles with the object of obtaining the blood-crystals. Of what influence the absorption of water is for the life and the functions of the blood-corpuscles, is evidenced by the following citations from authors of acknowledged high-standing.

"In order to avoid misconception, we would, however, observe in reference to the vitality of the blood-cells, that, if by the term 'life' we mean simply a group of physical and chemical agencies, having reference to morphological progressive and regressive development—vitality can no more be denied to the blood-corpuscles than to any other animal or vegetable cell." (Lehmann II. pp. 274, 5.)

This dictum of Lehmann, applies however to the healthy blood-cell, as we can observe it under the microscope in its normal shape—its vital condition; and of such blood he asserts, that: "to the blood-corpuscles we ascribe the function of absorbing oxygen, and giving it partially off in the capillaries." (p. 276.)

In relation to this vitality and the just named function, let us observe the blood-corpuscles when they have absorbed an abnormal quantity of water. "According to the quantity of water added, the lentil-shaped blood-corpuscles swell . . . . their concavity disappears and gives place to a convexity, until they assume a spherical form. The corpuscles are then very similar to fat globules. By the addition of common salt to this fluid the blood-corpuscles may again become apparent in their normal form; but if the blood has been treated with a very large quantity of water, the cell-wall completely bursts, and of course no addition of salt can then restore the integrity of the corpuscles." (p. 171.)

Klebs* designates "the spherical form as: the indication of death of the red blood-corpuscles."

We are involuntarily reminded of the description, given above by Mireur of the disintegration of the blood-corpuscles in the blood of Cholera-patients; and we very naturally suspect, that an abnormal absorption of water by the blood-corpuscles must be considered as one of the factors for developing a predisposition for Cholera. We can also find an easy explanation of the morbid alteration in the chemical constitution of the blood-corpuscles as described by Mireur and suspected by Rossbach; since as Rollett (p. 14) declares: the blood-corpuscles are destroyed through a number of agencies (among which also and chiefly Water) in such a manner, that they dissolve and yield up their hæmo-globin to the blood-serum. And Lehmann (p. 236) confirms this dissolution of the corpuscles. As the potash compounds and the phosphates predominate in the blood-cells, it is these salts which chiefly escape into the plasma; consequently these compounds are more abundant in the serum in Cholera than in a state of health.

We are then quite justified in assuming that this absorption of water by the blood-corpuscles brings these latter into such a condition, as will make them incapable of fulfilling their physiological functions.

It is impossible to doubt that these enlarged corpuscles, even before they have changed to the death-like spherical form, are unable to take up the oxygen in the lungs and give it off in the capillaries; that they have not the power of resisting the action of the Cholera—or any other similar poison; and that hence many symptoms of Cholera and other diseases find their explanation in this abnormal condition of the blood-corpuscles.

XV.

It is, however, a well-established fact, that this water-absorption depends in an inverse ratio upon the presence of Common Salt (Chloride of Sodium, Sodic Chloride, or according to the older designation Muriate of Soda) in the serum of the blood;

* Centralblatt f. d. med. Wissenschaft, 1863, p. 857.

so that an increase of Salt in the serum (within definite limits) determines a decrease in the water-absorption by the blood-corpuscles.

When it is desirable to show the circulation of the blood in the mesentery (of, for example, the guinea-pig), it is necessary to keep this delicate skin moist by means of water of blood temperature; to this water however, from 0·5 to 1 per cent. of Common Salt has to be added. Without this addition of Chloride of Sodium, the blood-corpuscles would absorb the water, swell up, become unable to pass through the fine capillaries and so cause a stoppage in the circulation—even if the corpuscles were not destroyed.

In acknowledgment of this important fact a solution of Common Salt of $\frac{1}{2}$ to 1 per cent. (Nasse* gives the most favourable strength of the solution at 0·6 per cent.) is called in Germany: Physiological Water; in England: Normal Saline Solution; and in France: Artificial Serum.

On the relation, which exists between the presence of Sodic Chloride in the blood-serum and the absorption of the liquid by the blood-corpuscles—experiments have been made, by which this inter-dependence has been definitely established.

"The affinity of the red blood-corpuscles for water depends upon the quantity of Common Salt in the blood, and is normal, when the latter is normal. If the latter is lowered, then the absorption of water augments. The solution of Salt, which is isotonic with the blood-serum, is the so-called 'normal saline solution,' *i.e.*, that solution which is least harmful to the blood-corpuscles and the tissues of the body."†

It is however not alone the water (as blood-serum) absorbed by the blood-corpuscles—but also the potash salt contained in the corpuscles, which interacts with the common salt in the blood-serum. On this point Lehmann says (III. p. 242): "It is a remarkable fact, that even in the blood of herbivorous animals, which take up almost solely potash salts in their food, there are in every 4 parts of alkaline carbonate in the blood-serum at least 3 parts of carbonate of soda, and only 1 of carbonate of potash, whilst in the muscular juice of carnivorous as well as that of herbivorous animals chloride of potassium is almost solely found. This fact, which was discovered and mainly established by

* Hermann Ia. p. 104.

† Zundt. Fortschritte der Medicin Band 9. No. 3, pp. 100, 101.

Liebig, shows, on the one hand, that the chloride of sodium in the blood must necessarily undergo an interchange of constituents with the carbonate and phosphate of potash, and, on the other hand, that nature has assigned very different parts in the animal organism to these alkalies, which are otherwise so similar, when considered from a chemical point of view."

This interaction of the potash-salts in the blood-corpuscles with the soda-salts in the blood-serum, gains in importance in relation to the question before us, when we direct our attention to the conditions under which Common Salt is met with in the human economy, how it exists in the blood, and its supply to and its elimination from the body.

"There occurs a fluctuation in the quantity of Common Salt, contained in the juices of the tissues, but it moves within narrow limits; the Minimum and Maximum lie so close together, that the percentage does not seem to vary much. It is still an obscure phenomenon, why, with an abundant supply, the blood does not show a higher concentration of salt; a certain quantity must, however, be retained, so that it cannot be removed, which is shown by the fact, that—when salt-supply is withheld—none is secreted by the kidneys, although the blood still contains a definite quantity."

"If no salt is taken with the food, then the organism gradually loses the salt contained in it; but it is the superfluous amount at first, and after that only very small portions of the quantity, necessarily required, until finally the concentration of salt in the blood and the tissues is lowered to a minimum, which does not further diminish. We must conclude therefore, that this portion of Common Salt, so tenaciously retained, is necessary for the existence and the various processes of the body; and that hence Common Salt, must be considered as a true nourishing Salt—an unquestionable food for the animal economy." (Hermann, VI. pp. 365, 6.)

"It has been suggested, that it has to fulfil the function of preventing the dissolution of the blood-corpuscles (Joh. Müller: Annalen der Physik, 1832), and the too great absorption of water by the tissues." (Hermann, p. 363.)

We are naturally induced to raise the question: When through circumstances, either natural or artificial—such as continued drinking and subsequent secretion of liquids—the salt in the blood has been reduced (**washed out**) to a minimum (Bequerel et Rodier, p. 66, give this as 0·2 per cent.) and when still further quantities of water have been supplied to the system: are we not forced to assume that, in consequence of this reduction of Sodium-Chloride to a minimum, the blood-corpuscles have absorbed the watery blood-serum to an abnormal degree, that some of them have perhaps been dissolved, become disintegrated — in fact killed, a greater number have swelled up, become enfeebled; and that thus the blood has lost its power of resisting the poison, which has accidentally found its way into the circulation?

It would not appear too venturesome to consider, that a certain physiological tension exists in the blood—between the blood-corpuscles with their potash-salts of the one part, and the blood-serum with its soda-salts of the other part—which tension would reach its highest degree with the minimum of Common Salt in the serum; and that with a further supply of water to the blood: this static tension would give way, allow the blood-corpuscles to be killed—dissolved—thus set free the potash-salts and the hæmoglobin, and so cause the symptoms of the various forms of blood-diseases?

Certainly! it can only be a limited portion of the blood, which may suffer, since the Sodium-Chloride, thus set free, would serve to protect the adjacent blood-corpuscles from destruction. But this destruction can proceed gradually (as stated by Mireur)* according as personal or local conditions favour the further supply of liquid to the blood, without a compensating supply of Common Salt.

The above consideration will greatly assist us in explaining such cases of the disease, which end so rapidly fatal; since it is not improbable, that this physiological tension may extend over the whole mass of the blood; may require only the slightest impulse to

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* See *ante*, page 31.

break down suddenly and spread its destructive action over the whole circulatory system.

This would be a physical phenomenon, for which an illustrative example could easily be found. As is well known: water, when allowed to stand very quiet, can be lowered in temperature below the freezing point without any ice being formed; but a grain of sand, thrown into it, will have the effect of causing the surface to be covered almost instan taneously with a film of ice.

XVI.

The attempt may now be made to investigate the effect, which a temporary-local disposition—a favourable environment, such as a period of high temperature with a dry atmosphere—would have on the condition of the blood for the development of the individual predisposition

In his definition of the temporary-local disposition (the *y*) for the outbreak of epidemic Cholera, Prof. v. Pettenkofer refers especially to the ground (or subsoil) water, in other words to high temperature and want of rain; and he applies these conditions to the vitality of the Cholera-germ. Let us however, consider the dry atmosphere, combined with a high temperature in their effect on the human body; and we shall find, that such local meteorological conditions promote evaporation of moisture from the skin, produce thirst and thus excite to drinking. Through a prolonged imbibing and a following secretion of liquid with a deficient supply of Common Salt to the system—the Sodium-Chloride present in the blood, is "**washed out**"—reduced to the minimum percentage; thus a continued drinking, produces the individual predisposition, which makes an infection of Cholera possible.

Involuntarily one is reminded, that habitual drinkers succumb to an attack with a mortality of 90 per cent. of the patients; that in Hamburg by far the greatest number of fresh cases occurred on Mondays and Tuesdays—because the Sunday and the Monday gave more occasion

for imbibing in the Beer-gardens and Music Halls; that similar observations were made in America and other places. Rossbach (p. 124) mentions in relation to this: "In many epidemics, it has been noticed, that a greater number of attacks take place after the Excesses of the Sunday, therefore on Mondays and Tuesdays, than on other days; . . . . all drinkers show a greater pre-disposition for Cholera."

The above stated effect of a high temperature and dry atmosphere —or any state or change in the meteorological conditions of the atmosphere on the human organism* will enable us to explain why: . . "in our climate most epidemics begin in warmer weather and end in winter;"—why: "Winter epidemics are exceptional and have shown the least tendency to spread;"—why: "it cannot be accidental, that in our climate the most violent epidemics do not occur in spring or midsummer—but in late-summer and in autumn" (Rossbach, p. 108) . . . . because it requires some time of warm dry weather to wash the salt out of the blood of these 'thirsty souls.'

To prevent a possible misunderstanding, it is necessary here to point out, that such a condition of the blood (*i.e.*, a destruction of part, and a deterioration of a still greater, if not the entire remaining portion of the blood-corpuscles) must not in itself be considered as the cause of a Cholera attack. Such a state of the blood may have no further consequences than a light summer-diarrhœa. But, according to the nature of the poison (or micro-organism) which may have entered the circulation, there will be developed as a result of this susceptibility, this individual predisposition—either Cholera (asiatica or nostras), typhoid, dysentery or other similar "blood"-disease

Of what importance however—in face of the above expounded individual predisposition—must appear the character of the potable water, in which it is next to impossible, to discover by all microscopical and chemical means at our disposal, any mineral or organic impurities. We might be induced to look upon the presence (or perhaps the

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* Dr. Wall (in his excellent work on Cholera, London, Lewis, 1893, page 137) states: In India a constant phenomenon of Cholera is its increase with a fall of rain that has succeeded a period of drought. No doubt, owing to the sudden check to the evaporation and from the skin, causing accumulation of water in the blood.

absence) of a gas in the water as a dynamic factor for the development of the disease.*

With the above conception of the nature of the individual susceptibility, it can be no difficult task to explain: why, with the appearance of rain the cases of Cholera are diminishing in number: since, with the advent of rain, which is mostly accompanied by a lower temperature, the exhalations of the skin and the resulting thirst are correspondingly diminished, and thus a check is exercised in the further development of the predisposition in many individuals.

In fact: a rainy season appears to be antagonistic to Cholera, as specially pointed out by Prof. v. Pettenkofer (p. 20), who states that in Calcutta, which lies well within the endemic region of Cholera, the minimum of the Cholera-cases, according to the statements of Cunningham, Bellew and others, occurs in August, sometimes in September and the maximum in January up to April —mostly in the latter month. The mean temperature of April in Calcutta is 30° C. (86° F.) and of August 28° C. (82° F.) that is practically the same. . . . . A great difference exists however in another climatic factor. The mean rainfall in April is 60 and in August 365 millimeter. In plotting the monthly number of fatal Cholera cases and the monthly Rainfall, a surprising result is obtained: The two curves are opposed to each other.

We can interpret this by saying: during the heavy rainfall, the exhalations of the skin are suppressed, and thirst is not abnormal; the individual predisposition is not so highly and numerously developed and the cases of Cholera-attack are lessened in number. Again, it deserves mention here as rather surprising, that this climatic factor is only considered in its bearing upon the state of the sub-soil water, and the vitality and virulence of the Bacillus—but not in its influence upon the human body for the development of the individual predisposition.

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* This view of the etiology of Cholera deserves to be fuller elucidated by study and experiment; since the Comma-bacillus, as the "causative agent," becomes daily more surrounded with increasing doubt.

Dr. Wall's exposition of this latter question seems to be unanswerable. (On Asiatic Cholera, pp. 128, *et sequ.*)

The above hypothesis of the individual susceptibility will also enable us to find an explanation of the epidemic outbreak of Cholera during the colder winter-months, which has always been an enigmatical point in the etiology of the disease. Professor v. Pettenkoffer, referring to this, observes (p. 21): The climatic conditions with regard to rainfall explains to us, why Hamburg and Berlin during twenty-seven Cholera periods, have never experienced a winter-epidemic; whereas Munich has been thus visited twice. The Government Reports of the meteorological conditions of Hamburg, Berlin and Munich, show, that during the latter part of the autumn and in the commencement of the winter, North Germany (including of course, Hamburg and Berlin) is subject to an increased rainfall, as compared with Munich, in which city it is the reverse.

So also the sudden, almost explosive outbreak of Cholera in Hamburg in August, 1892, will find an explanation in the continued high temperature, prevailing there during that period. The report of the Imperial "Seewarte" (Marine Meteorological Institute) states: "that the summer of 1892 was in Hamburg abnormally hot and dry."—This caused the individual predisposition to develop so rapidly and so favourably for the sudden outbreak and extension of the disease.

There remains now to make the attempt of explaining the outbreak of Cholera during a temperature so low, that the mercury freezes—as happened in Norway. In these cold latitudes the inhabitants endeavour to counteract the cold temperature by the use of alcohol; this latter is, however not always taken undiluted, but mostly mixed with water. Furthermore: dress is naturally of a thickness and a texture to keep the body warm and hence favourable for promoting exhalation of the skin; whilst a deficient action of the skin is mostly compensated for by an increased expiration of moisture by way of the lungs, and an excretion of water through the kidneys; so that during prolonged dry cold weather, a habit of drinking with an insufficient supply of chloride of sodium to the system—a predisposition can be developed even in the coldest temperature.

On the whole—we must bear in mind, that at most only 7 per cent. of a population are attacked and about 4 per cent. succumb to the disease; and that only in these 7 per cent. have we to account for the susceptibility to an attack of Cholera.

This fact alone should impress us with the true individual character of the predisposition for the disease. Whether we make the inhabitants of Hamburg, of Bergen, or of filthy Srinagar the object of our inquiry—in any case we have to confess, that all the factors, which are favourable for the outbreak of Cholera:— the disease-germ, as also the local temporary (climatic-) conditions, to which all the inhabitants of a city or a district are exposed—must be of a feeble power as compared with the Individual Immunity, through which over 90 per cent. are protected against the disease.

As the susceptibility—the predisposition for Cholera appears, according to the above exposition, to have its seat in the blood—we are naturally induced to direct all our energy: to bring the blood into a condition, under which it possesses the desired Immunity against the attack of the Cholera-poison.

XVII.

The preceding remarks must have made it sufficiently evident, that the particular condition of the blood, which constitutes the individual predisposition, is not so much the too great a quantity of water in the blood, as it is the **deficiency of Sodium-chloride**; it is hence desirable to make ourselves acquainted with the Supply, the Use and the Secretion of Common Salt in the human body, in special relation to the habits and the views, which exist in the popular mind about this important question.

Here we are met by the singular phenomenon that not only the "common people—laymen," but also their hygienic teachers, look upon the supply of Common Salt to the human system with great indifference, and in some instances express a warning against its use. In this tirade, a sect of extreme Vegetarians, who decry fanatically against the use of Salt as a hygienic sin—is associated with some members of the Medical Profession, who positively prohibit the taking of Common Salt with our food.

Nay, even physiologists of renown, declare that Nature has already provided our food with so much Common Salt, as will suffice for our physical well-being; that any further addition of it, is simply an evil habit; and Dr. med. Howard actually represents in his book: "Salt, the forbidden fruit," the use of Salt in every way as dangerous.

In the same or similar strain we find the more modern authors express themselves. Professor G. Bunge (p. 116) for example, says (in spread-type, to accentuate his meaning): "Besides, I have to emphasize, that the quantity of Salt, which we add to our food, is much too large;" and he entertains the fear (p. 117) . . . . "that the kidneys are not adapted to eliminate so large a quantity of Common Salt (20 to 30 gram. daily?)."

Such a Dictum, coming from a scientist of so high a standing, to whom we naturally look for information on questions like the above, must undoubtedly have the effect of making us indifferent and neglectful in the use of Salt; although we shall find, that some writers—and even Prof. Bunge himself, and he especially—insist upon a certain quantity of Sodium-chloride as an absolute necessity for the healthy existence of the human body.

It would be out of place here, to enter further into the question of the great importance generally of the supply of Salt to our system; it must suffice to have pointed out, how the use of it has not received the deserved attention and has been seriously neglected, owing to the publicly expressed advice of our hygienic teachers.

With regard to the importance of this question, Prof. Bunge gives expression to it in the following words (p. 116): ". . . . 'The injustice of the Salt-tax' must become strikingly manifest. For the poorer the human being, the more is he forced to seek food among the vegetable products, which are rich in potash; and as a necessary result his consumption of common salt must increase proportionately." And to show the absolute necessity of the use of Salt, he cites (p. 111), what Mungo Park relates of the desire for Salt by the negroes in Africa: "In the interior, Salt is the greatest luxury . . . . I myself have suffered greatly through the scarcity of this natural product. The constant use of vegetable food excites a painful, indescribable longing

for Salt." And further on he relates, that the Battas of Sumatra make their solemn declaration in the form of an oath at legal proceedings by the formula: "That my harvest may spoil, my cattle die, and I never eat Salt any more, if I do not speak the truth."

In accordance with the above statement and, as we shall see further on, in agreement with his own theory and valuable discovery of the interaction between the potash and the soda-salts, we should expect, that Prof. Bunge should favour a liberal use of Common Salt, and recommend it within certain limits;—yet we hear him declare, that: "It is impossible to deduce *a priori* the necessity of a constant supply of considerable" (?) "quantites of Salt to the full-grown human organism."

The use of Common Salt is, in relation to the question before us, of double importance; not only as it bears upon the supply of the necessary quantity to the blood for the maintenance of the physiological functions of the latter—but also and especially with regard to the mischief of an accumulation of free potash salts in the blood-serum as a cause for developing a predisposition for Cholera (and, let us add, other mortal ailments). Prof. Bunge gives us most definite information on this point, which is of the greatest importance and deserving of our fullest attention.

He says (pp. 106, 7): "It is a remarkable fact, that of all the inorganic Salts of our body, there is only one, which we take from inorganic nature and add to our organic food—viz.: Common Salt Of all other Salts we are satisfied with the quantities that are naturally contained in the organic substances of our food. We never need exercise any care about them. With the supply of the organic food-stuffs we receive the inorganic salts in the bargain. Only Common Salt makes an exception. And this exception is the more striking, since our food is by no means wanting in Salt. All vegetable and animal food-stuffs contain considerable quantities of Chlorine and of Sodium. Why are these quantities not sufficient? Why do we search for and use Mineral-Salt?"

Professor Bunge then directs our attention to the difference in the use of Salt between the Herbivora and the Carnivora; and to the fact, that it is chiefly the former, who evince this great desire for adding Salt to their food.

"This difference is all the more surprising, since the quantity of Sodium-chloride which the Herbivora find in their food . . . . is mostly

not much less than what the Carnivora obtain. There exists however a marked difference in another mineral constituent of our food-stuffs, viz.: Potash. The Herbivora consume at least two to four times the quantity of this salt, as compared with the Carnivora. This fact led me to suspect, that the abundance of the Potash-salts in vegetable food was the cause of the great desire for and consumption of Common Salt among the Herbivora.

When, for example, a solution of a potash-salt, such as carbonate of potash, intermixes with a solution of common salt (*i.e.* chloride of sodium) a partial interchange occurs; resulting in chloride of potassium and carbonate of soda. But chloride of sodium is, among the inorganic salts, the most essential and necessary constituent of the blood-serum. Hence, when through absorption of the food, potash-salts enter the blood, a transposition takes place within the latter. Chloride of potassium, and a soda salt of the acid, which was combined with the potash, will be formed. In lieu of the Chloride of Sodium, the blood now contains another sodium-salt, which is heterogeneous — abnormal to the healthy constitution of the blood, at all events abnormal in quantity. A strange ingredient, or a surplus of a normal ingredient — for instance: carbonate of soda — has formed in the blood."

"It is now the function of the kidneys to maintain the normal healthy condition of the blood, hence to eliminate every foreign, or the surplus of a normal constituent. As a result, this newly-formed sodium salt, as also the chloride of potassium will be excreted by the kidneys and the blood will have become so much poorer of Chloride of Sodium."

"The introduction of Potassium-salts has therefore deprived the organism of Chloride of Sodium. This loss can only be made good by a supply of Common Salt from without."

"I have made experiments upon myself with all the various potash-salts, which are contained in the usual alimentary substances. 18 grm. of K_2O as a phosphate or a citrate, taken in three doses in course of a day, abstract from the body 6 grm. of Common Salt, besides 2 grm. of sodium; since this interchange—this transposition—does not only occur between the Potash-salts and the

Common Salt, but also with other combinations of Sodium, such as the carbonate-, the phosphate-, and the albuminate- of soda."

"The quantity of potash, which was introduced into the human body in these experiments, was by no means so very great; it was considerably less than the quantity of potash, contained in the most important vegetable food-stuffs. And yet **it withdrew from the body 6 gram. of Common Salt.** This is about **one-half the amount of Common Salt contained in the 5 litre of blood of an adult human being.**"

XVIII.

Let us now consider this important discovery of Professor Bunge in connection with that condition of the blood, in which, as described above, the Common Salt is reduced to a minimum—when it will appear as highly probable, if not incontestable: that the potash salts, taken as constituents of our food, interchange with the Chloride of Sodium in the blood; that this latter, so necessary for the very existence, for the life of the blood—is changed into a phosphate or a carbonate of Soda and thus excreted—expelled from the system. But this abstraction of Common Salt must be the cause of a corresponding number of blood-corpuscles absorbing abnormal quantities of a watery blood-serum; they are thus killed—burst and so diffuse their potash-salts as well as their hæmoglobin into the blood-serum;—a pathological phenomenon so conspicuous in cases of Cholera.

It is however not necessary that we should assume a complete destruction of the corpuscles in our attempt of explaining the individual predisposition for Cholera; the simple distension—the swelling—the softened globular form—of the blood-corpuscles, resulting from the abstraction of Common Salt from the blood—through a food rich in potash-salts—will suffice to explain that deteriorated condition of the blood, which will cause the blood-corpuscles to become the victims of the Cholera-poison.

Prof. Bunge gives us some highly interesting and most important information about the direct effect produced by a free potash-salt in the blood-serum (pp. 135, 6). Although he convinced himself by experiments upon his own person:—that such doses (about 12 gram.) taken direct into the stomach, which can be borne without vomiting, have no influence upon the action of the heart"—this question

assumes a different aspect, when "**the potash-salt is injected direct into the blood.**"

"Through my own experiment I have convinced myself, that the injection of 0.1 gram. of chloride of Potassium into the jugular vein of a dog of medium size **instantly causes the heart to stand still.**"

To recapitulate :—

——— through a continuous imbibing of liquid, without a compensating supply of Common Salt, this latter is washed out of the blood to a minimum ;—

——— this reduction of Common Salt in the blood causes the blood-corpuscles to absorb the watery blood-serum ; they swell, assume a globular form and become incapacitated to perform their physiological functions besides losing their power of resisting any organic poison, that may enter the circulation ;—

——— the partaking of food rich in potash-salts (again without a compensating supply of Common Salt) deprives the blood still further of its protecting ingredient—(since it cannot be unreasonable to assume that this chemical action between the potash- and soda-salts is powerful enough to break through the physiological tension, by which the blood retains the safe minimum amount of Common Salt—0.2 per cent.) ;— as a consequence, the blood-corpuscles disintegrate and their potash-salt and hæmoglobin are set free in the blood-serum ;—

——— and, whether effected through the toxic agency of the Cholera-germ, or the simple deprivation of the protecting medium, the Common Salt—this destruction of the blood-corpuscles will cause, through the diffusion of a free potash-salt in the blood-serum, **the paralysis of the heart with all the concomitant symptoms above referred to.**

It cannot appear difficult now, to explain the many local epidemics of Cholera, such as the one at the Lunatic Asylum at Nietleben near Halle ; in which a supply of food, rich in potash-salts, with a deficient supply of Common Salt, might have caused the individual predisposition to be so strongly and locally developed. Many mysteries in the phenomena, which surround the outbreak and spread of the disease, would find an explanation in the above theory ; and this should certainly give incentives to submit these phenomena to further investigations.

Bunge's remarks point in this direction, when he says (p. 117): "When effecting our nutrition by means of meat and bread, without addition of Common Salt, we excrete in twenty-four hours not more than from 6 to 8 gram. of salts of alkali. When feeding on potatoes and the corresponding addition of salt, more than 100 grm. Alkali are expelled by the kidneys. Is there not some danger involved?"

Although, in expressing this fear, Bunge refers to the kidneys only; yet it would appear from the above inquiry, that a danger exists also and especially for the life of the blood; and the whole question of the comparative quantity of the potash- and soda-salts in our food, becomes of paramount importance.

It will be of interest and highly instructive to note the presence of these salts in the various alimentary substances as given in the following tables, which are copied from Prof. Bunge's Physiology (p. 114).

List of alimentary substances with regard to their contents of Potash- and Soda-salts.

TABLE I.

1,000 Parts by Weight of Dried Substances contain:				
Arranged according to the quantity of Potash.	K_2O	Na_2O	Arranged according to the quantity of Soda.	Na_2O
Rice	1	0·03	Rice	0·03
Ox-blood	2	19	Apples	0·07
Oats, Wheat, Rye, Barley	5-6	0·1-0·4	Beans	0·13
			Peas	0·17
			Clover	0·17
Dog's Milk	5-6	2-3	Oats, Wheat, Rye, Barley	0·1-0·4
Human Milk ..	5-6	1-2		
Apples	11	0·1		
Peas	12	0·2	Potatoes	0·3-0·6
Milk of Herbivora	9-17	1-10	Meadow Hay ...	0·3-1·5
Meadow Hay ...	6-18	0·3-1·5	Human Milk ...	1-2
Beef	19	3	Dog's Milk	2-3
Beans	21	0·1	Milk of Herbivora	1-10
Strawberries... ...	22	0·2	Beef	3
Clover	23	0·1	Ox-blood	19
Potatoes	20-28	0·3-0·6		

The following table gives the relative amount of Potash for each part of Soda.

TABLE II.

For one Equivalent of Na_2O we find:			
IN	Equivalent of K_2O	IN	Equivalent of K_2O
Ox-blood	0·07	Barley	14-21
White of Egg	0·7	Oats	15-21
Yolk of Egg	1·0	Rice	24
Whole body of a Mammal	0·7-1·3	Rye	9-57
		Meadow Hay	3-57
Milk of Carnivora ...	0·8-1·6	Potatoes	31-42
Beetroot	2	Peas	44-50
Human Milk	1-4	Strawberries	71
Milk of Herbivora ...	0·8-6	Clover	90
Beef	4	Apples	100
Wheat	12-23	Beans	110

In relation to the question, which immediately engages us, it deserves special notice, how great the amount of Potash is in fruit and in those vegetables* which are so prevalent on our tables during the summer, to find in it a support for above theory of the individual predisposition; and an explanation of the fact, that **an abundant supply of food rich in potash salts without a corresponding supply of Common Salt, will develop a predisposition for Cholera.**

XIX.

Although the two above-named factors, viz.: a continuous abnormal imbibing of liquid, and the use of food rich in potash-salts, must be considered as the chief causes of the abstraction of Chloride of Sodium from the blood and a consequent development of the individual pre-

* See also: Moleschott, Prof. I., Physiologie der Nahrungsmittel, 2, Auflage, Giessen, 1859.

disposition for Cholera and allied diseases—we must not omit to recognise an auxilliary factor in several functions of the human body, which demand the presence and subsequent excretion of Common Salt; and that hence practically the ordinary supply of Salt, which we naturally obtain in our food, is not so great as has been assumed.

The insufficiency of the supply of Common Salt to our organism becomes especially apparent when the various secretory processes of the system are considered. "In the secretion of the liver, the bile of land-animals, we find a predominating quantity of oxide of sodium, the sodium of which was received in the food as common salt . . . . and accurate observations may perhaps show, that . . . . the passage of urea into the circulation and its excretion by the kidneys, have a closer relation with the presence of common salt in the blood, than is generally supposed." (Liebig II., pp. 406-8.)

With the secretions of the liver and the kidneys, the Chloride of Sodium is however lost to the organism; and it is no unimportant question to ask: whether the quantity of common salt, naturally taken in, or moderately added to our food, is sufficient (as Prof. Voit declares, p. 364)—to maintain these secretory processes in the necessary degree.

Suffice it here to point out, that these secretory processes have a tendency to lower the quantity of Salt in the blood to the absolute minimum, and thus assist in the development of the individual predisposition. Not to mention, what influence such a deficiency of Common Salt in the blood must have on the accumulation of Urea and Uric Acid in the body and the many ailments resulting therefrom.

XX.

It deserves mention here, that the employment of Chloride of Sodium for the **Cure** of Cholera has been recommended and tried forty years ago; but without any satisfactory result. It appears that the chief object was, simply to restore the lost salts to the blood, without any clear idea, as to the nature of these salts in relation to the life of the blood-corpuscles. One of the first to attempt the Cure of Cholera by the administration of Salts to the system was Dr. W. Stevens. In his book (The Asiatic Cholera, London, 1853) he declares

in answer to the criticism, which his theory of the disease had evoked: "For, if it be true, that the vital electricity, which the salts of the earth receive from the vital air, is a life-giving remedy for the Cholera poison, that is far more certain in its results than any or than all of the boasted specifics, that the medical faculty possesses, either for the cure of Cholera or of any other fatal disease, then time will tell, that the mental knowledge of this fact will be far better than gold, yea, than refined gold to the human race."

And throughout his treatise he speaks of: "electric salts" and "vital salts"; whilst about his proposed treatment for curing the disease, he informs us, that: "Patients, presenting merely the first stage of premonitory symptoms, diarrhœa and vomiting, were removed to an **observatory** (!) ward . . . . On their admission a **Seidlitz** powder was administered . . . . and three or four tea-spoonfulls of **Epsom Salts**" (Sulphate of Magnesia) "were added to the Seidlitz powder . . . . and thirst was relieved with **Seltzer**– soda- or pure-water *ad libitum* . . . . if cramps, coldness, or sinking of the pulse were present . . . . the non-purgative salts were administered every half-hour: Muriate of Soda; Carbonate of Soda, **Chlorate of Potash.**"

It is not surprising, judged by our present knowledge, that such treatment for curing the disease, should not have had the desired result, and that it was hence attacked and severely criticised. To dwell upon it here, is chiefly done with the view of pointing out why the employment of Common Salt (held in the same category with all other salts) came into disrepute, and excited doubt and opposition from the very commencement.

Not only the want of insight into the real nature of the disease, which was defined in fantastic pseudo-scientific terms, such as were acceptable and current at that period*; but also the employment of such salts as Carbonate of Soda, and above all a potash-salt, will place the whole theory and procedure of Dr. Stevens in the proper light, to silence all attempts, that may be made to defend it.

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* Although even now, forty years later, with Board-schools and Technical Colleges spread over the land—the word electricity is frequently invoked to cover a lamentable misunderstanding of scientific phenomena.

Since then many physicians have employed the injection of solutions of Common Salt in the treatment of the disease; but in almost all instances another soda- or even potash-salt has been added. This therapeutic remedy seems however to be resorted to when the patient has reached the asphyctic stage, the stage of collapse; always with the intention to cure and not to prevent. When it is borne in mind that the dead blood-corpuscles, when once disintegrated — destroyed—cannot have life restored to them, it must be evident, how little successful such an injection of a solution of Common Salt during the fatal, the mortal stage of the disease has proved itself.*

What after all it is possible to achieve by means of an injection of a Salt-solution in a fully developed attack of Cholera is: to check the further destruction of the blood-corpuscles, and to restore the distended, swollen corpuscles to their normal shape, to enable them to absorb oxygen; to give thereby fresh life to the heart and new vigour to the circulation; and when the injection of a solution of Chloride of Sodium has been applied in good time, satisfactory results, no doubt, have been obtained; but simply because it was applied early enough.

On the whole, however, these injections have been employed more for the purpose of replacing the water, which the blood has lost through the evacuations—for which a "normal fluid" (*i.e.* a solution of Common Salt) is necessarily employed, to maintain, or if possible restore the circulation—than the more important task, according to the above theory: of saving the blood-corpuscles, which have escaped destruction; to deprive the softened, weakened, swollen corpuscles of their watery serum, restore them to their normal form and so enable them to perform their proper function.

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* In the "Medical Annual" 1893, Dr. F. Reiche in his report on the Medical Treatment of Cholera in Hamburg, 1892, refers to the employment and relative value of Injections in the following words: "It is beyond dispute that by this means and this alone, a large number of patients were saved." But he values them (the injections) only in so far as by their employment "a warm liquid is infused into the Blood circulation." (Drs. Reiche and Wilckens in Jahrbücher der Hamb. Staatskranken-anstalten Band III. p. 145). See *Appendix*.

The true value of this injection finds its expression in Cantani's remarks upon it. It is only necessary to give a few extracts from his exposition of its application to illustrate this.

"I myself," he says (p. 24) "theoretically convinced of the utility, the introduction of Water" (be it noted: not Common Salt) —"by whatever process, which leaves Stomach and Intestines undisturbed—must have in severe Cholera-cases, have recommended the injection of warm salt-water under the skin already in 1865."

"The subcutaneous infusion, or as I have called it: 'hypodermoclysma,' was practically applied by me, using sterilised Water of 38°, 39° to 40° (blood) temperature, in which were dissolved 4 gr. of Chloride of Sodium and 3 gr. of carbonate of soda per litre. . . . ."

"In no single case was the injection followed by any bad symptoms; on the contrary in all cases, sometimes in the agonies of the critical period, when all hope was abandoned, was it at least of temporary, and in many cases, **when not applied too late**—*solatii causa*—of permanent relief, which saved the patient." . . . "It is necessary to add, that, when the hypodermoclysma had not a life-saving effect, it had at least symptomatically a more certain and rapid result, than all the stimulants of the house" (family medicine chest) "or the Chemist's shop; from Tea, Champagne, and Punch—to the Ether-injections."

Such results surely cannot excite our pride.

It certainly cannot be recommended, upon the first indications of a Cholera attack to employ such heroic means as an intravenous or subcutaneous injection; since it is not so difficult to furnish the blood with the required quantity of Common Salt. To do this it is necessary not to await the severe, the dangerous, the asphyctic stage—in fact not any attack at all—but to supply the salt to the system as a prophylactic, and to effect this in a manner, different from the usual habit of taking the salt with our food, whereby often an abnormal thirst is produced.

The most natural method of supplying Common Salt to the blood —as corresponding to the historic-morphological development of the human body, would be perhaps by way of the skin in a warm salt-water bath*; and if not already done, the attempt might be made to treat a

* Oken, in his Physio-Philosophy (translated for the Ray Society by A. Tulke § 901) considers all organic life to have been developed out of sea-mucus; and that

Cholera-case by immersion in a salt water bath of blood temperature for a prolonged period.

XXI.

When Common Salt is added to food in larger quantities, than is necessary, to make it (the food) palatable, it excites more or less thirst, according to the quantity so added, and according to past habits in this respect of the individual.

When however the salt is dissolved in fresh cold water (in cold weather and for stomachs, that are sensitive to cold—with the chill taken off)—and the solution in its strength does not deviate much from the proportions of the above-named normal fluid—it will, when taken, occasion no thirst. The easiest way of preparing such a solution is: by putting 6 to 8 gram. of fine dry Common Salt into a litre (or quart) bottle and fill the latter with fresh filtered water. Or, for immediate use: one gram. of salt (always dry, finely powdered) is put into a tumbler and water poured on it till the tumbler is half-full; to be taken as soon as dissolved. This freshly prepared solution is considered by many—who have taken such a draught every morning for years with most beneficial result to their general state of health—as more palatable. For this daily dose, the solution should never be so strong that the salt can be tasted; and after a few mornings the quantity of dry fine salt for one dose can be readily estimated without weighing or measuring. During Cholera times and in fact during the hot summer-months it is advisable never to drink water without a slight addition of Common Salt. For the purpose of curing sickness at stomach and a tendency to vomiting—or in case of a bilious attack—it is advisable to take a dose of the solution slightly stronger than the above mentioned proportion.

(§ 913); "Man also is a child of the warm and shallow part of the sea in the neighbourhood of the land."—Prof. Bunge (p. 118) is convinced: "that the high per centage of sodic chloride to be found in the bodies of the vertebrate animals, as also our great desire for salt to our food, can only find a satisfactory explanation in the doctrine of the descent of man." And in relation to the constant presence of Common Salt and its important functions in the histological development of the human body, the same author remarks: "These are facts, which can find a proper explanation only in the assumption that the vetebrate animals of the continents had their origin in the sea."

So also for the quenching of an abnormal thirst (for example after partaking of salt-fish or other highly salted food) when fresh (salt-less) water will prove ineffective—a dose of the salt solution will have the desired result.

A bacteriological fact, now well established, which points to a direct connection between Common Salt and the Individual Predisposition cannot be left unnoticed here.

All experiments on the vitality of the Comma-bacillus (presuming that this microbe is the cause of Cholera) have confirmed the fact, that the latter is killed in acid media; and it is very natural to conclude from this, that this individual Immunity is most probably based on the presence of an acid in the gastric-juice, which deprives the bacillus of its vitality before it can infest the intestinal canal. For the formation of this acid (hydrochloric acid—which is the normal acid of the gastric juice) the presence of Common Salt is required; although for the purpose of killing the microbes lactic acid may be equally efficient. (It is however very questionable whether this organic-acid—which is by comparison easily decomposed—is on the whole capable of replacing the inorganic—the hydrochloric acid in the digestive process and for the protection of the peptons against abnormal and sometimes poisonous organic substances). Suffice it here to repeat, what Dr. O'Sullivan says in his lessons of the Hamburg Epidemic on the question of the individual predisposition: "What precisely constitutes this predisposition to develop Cholera is, as yet, a disputed point; but it is a significant fact that about five per cent. of most communities are found to have an alkaline or neutral instead of a normal (acid) stomach reaction, and it is well known that alkaline or neutral media are as favourable to the growth and multiplication of the special microbe, identified with an attack of Cholera, as acid media are inimical to the same."

It is, without further comment, left to the thoughtful reader to apply his own judgment to the question of Cholera-prevention by a regular systematic supply of Common Salt to our system; and the opportunity is open to everyone, to confirm by an experiment upon himself, how such a regular daily supply of Chloride of Sodium (taken fasting

every morning) contributes (it is after all no panacea) to promote the general health, and to prevent, if not completely yet the dangerous symptoms of Cold, Influenza and many other ailments.

In relation to the main question before us, we are justified, in accordance with the above exposition of the subject, to declare it as more than highly probable, that a **liberal systematic supply of Chloride of Sodium to the Human Organism imparts to the latter an Immunity against Cholera.**

XXI.

No reasoning powers nor scientific proofs—not even the single or repeated instances of the prevention and cure of Cholera-cases can suffice to establish the infallible efficiency of Common Salt as a prophylactic and a remedy against Cholera; to effect this, it is necessary to institute a systematic and methodical experiment under special conditions; so that there remains no doubt about the result.

It would be a futile attempt, were this knowledge of the preventive effect of Common Salt diffused promiscuously without method and without circumspection. To arrive at an incontestable conclusion, and so insure the general application of this simple means, nothing less than an appeal on the part of a Government or Municipality—addressed to all the inhabitants of a town or district, in which an epidemic has broken out, will suffice to make sure of the general application of the remedy, and thus to stamp out the epidemic in course of a few days.

With regard to the manner, how such an experiment should be carried out, and what advice should be given to the general public, the following suggestions are offered: In the case of an outbreak in a prison, an asylum or other similar institution, it cannot be very difficult to give the necessary instructions to the inmates; to watch over the carrying out of the advice and to control the result. When however the experiment is to be made in a city or district, containing a considerable number of inhabitants—it is absolutely necessary to make this appeal to the public by means of Wall- and Hand-bills, which should be distributed over the entire locality within a few hours, to insure the general

simultaneous application of the prophylactic remedy and make the result all the more striking and convincing.

Subject to further improvements and alterations, these printed Wall- and Hand-bills might be worded as follows :

" Want of Common Salt in the human body predisposes this latter for Cholera and other similar diseases."

" Hence : Salt should be added to all food, only however, to the extent of making the food palatable; but besides this, it is necessary that it should be taken independent of food in the following manner :

" Take the best salt (chloride of sodium—common salt—cooking salt—table salt) dry it well, pound it fine and keep it in a bottle to protect it from the moisture of the atmosphere (for which it has a great affinity). Take for one dose or draught about as much as will lie upon a shilling, place it in a tumbler and pour fresh cold (if at all possible filtered) water upon it, until the tumbler is about half full ; when dissolved drink it all but the last few drops. This should always be taken fasting ; and should the solution be not quite palatable, it can be made so by the addition of a little more or less water. The salt should be scarcely or only slightly tasted. One draught should be taken at least once a day; but during an epidemic of Cholera whenever thirst demands it ;—water should never be taken unless containing some addition of common salt. To prepare the solution with the view of having it constantly in readiness—put 6 gram. of salt into a litre-bottle and fill this up with fresh cold filtered water."

" Sea-water or any of the natural or artificial mineral waters are doubtful if not harmful substitutes ; and the simple solution of common salt in water, as above advised, is the best tonic, a most necessary food for the body, and a most effective prophylactic (preventative) against Cholera."

XXIII.

Every thoughtful reader of the foregoing dissertation will naturally raise the question, whether and to what extent we may be justified in demanding of a Government or a Municipality a practical methodical

experiment for the verification of the above theory. No doubt, such a proposed experiment would be submitted to the Medical Faculty or the Government Department of Health or the Sanitary Council of the State, and left to the Medical Profession for a decision ; who however among the members of that Faculty will have the courage to publicly patronise an experiment, which has for its object to instal so common a substance as Common Salt into the position of a powerful prophylactic against so formidable a disease as Cholera ?

Do not let us conceal the fact, that among the members of the Medical Profession (with very notable and numerous exceptions : see Dr. H. Wehberg's Physic-credulity of Physicians) there are a great many minds too much disposed to seek the *vis medicatrix* outside the human body, and hence give preference to heterogeneous remedies as compared with those which are too simple, too popular, and too general, such as Common Salt is. Besides, the professional prejudice among the doctors is a great hindrance to the adoption of propositions, which do not emanate from the highest authorities of the Faculty. And unfortunately—even those of the so-called "lay-world," who pride themselves upon a higher education, are so criminally ignorant (criminally—because their ignorance is often the cause of many diseases and even death) about the human body and its functions, that Medical Men stand in relation to them like the ancient Priests, who had to guard the mysterious "All-holy"—and are far too powerful, as to yield so readily to an appeal addressed to them by their lay-brethren.

In consideration however :

———that even Physicians of acknowledged high standing admit their impotence in the cure of Cholera ;

———that in consequence : all kinds of propositions are still advanced and tried to discover a therapeutic means of treating the disease effectively ;

———that—if improved water supply and sanitary drainage have had the effect of checking the spread of Cholera in large cities : – the outside world is still subject to Cholera-epidemics ;

——— that—notwithstanding the discovery of the Comma-bacillus, the true character of which, as the originator of Cholera is becoming daily more doubtful—the chief causes of an epidemic and of the individual case remain an unsolved problem ;

——— that even under the most favourable conditions for the outbreak of the disease the Cholera-poison has no effect upon insusceptible people;

——— that through individual Immunity already over 90 per cent. of a population are protected against Cholera;

——— that the theory of the individual immunity and of the proposed remedy for the prevention of the disease—as expounded in the preceding dissertation—has more than any other theory—hitherto advanced—a true scientific foundation, and stands in better harmony with the various symptoms of the disease and with the many epidemiological phenomena;

——— that such a methodical experiment for establishing and confirming the proposed prophylactic means for the prevention of Cholera —can be made with comparatively little trouble and expense;

and lastly

——— that—when once the efficacy of this simple prophylactic, which is almost universally accessible and easily applicable by all human beings—has been confirmed, a great blessing for mankind will have been achieved;

in consideration of all these points—every government and every municipality should consider it a duty, to undertake and to promote (or at least to sanction with its authority) the above suggested experiment, whenever and wherever an opportunity may offer itself.

May the Governmental and Municipal Authorities become conscious of their duty in relation to this question, and find among the philanthropic wealthy (who could gain immortal fame with comparative infinitesimal expenditure) and also from the liberal-minded members of the Medical Profession, the necessary support for such experiments—with the object of conquering this scourge of humanity.

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APPENDIX.

A.

SYNOPSIS OF THE CONTENTS.

I.

We are still ignorant of the true Nature of Cholera and of the proper means for combating the disease. Not only is this generally admitted (at least by all competent unbiassed Physicians) but it is evidenced by the many new remedies and methods of treatment, suggested and tried.

II.

Endeavours have been made to solve the whole question by a *coup de mot*—by declaring Cholera a Dirt-disease. This latter is contradicted by the experience in Paris, Copenhagen, &c., &c., and especially by the epidemic in Kashmir in 1892.

III.

Dr. Koch's Comma-bacillus is generally considered as one of the factors for the outbreak of Cholera; yet: numerous experiments on human beings have proved the impotence of the microbe to produce the disease—whilst the presence of bacilli in the evacuations of Cholera patients is quite uncertain.

IV.

Favourable temporary local conditions have been advocated as an effective factor in the production of a Cholera-epidemic; but the observed facts have not supported this assumption.

V.

The third factor: the Individual Pre-disposition has received the least attention.

There are human beings, who are insusceptible for Cholera; who even, when infected, do not develop the disease.

VI.

Under most favourable conditions for the outbreak of Cholera—(with the Cholera-poison and the local pre-disposition in full force)—on an average about 5 per cent. of a population develop the disease. The other 95 have escaped—not through accident—but through a natural constitutional Immunity.

VII.

Every phenomenon in connection with the disease, points to the fact: that the individual predisposition is the chief factor in the development of Cholera; and how far the virulence of the Cholera-poison—in fact the whole bacteriological science is mocked and derided by the observed facts .... was proved by the child, which during the Hamburg Epidemic—therefore under unquestionably most favourable conditions for the development of the disease—swallowed the dejecta of the father (mistaking it for gruel) without suffering in the slightest degree.

VIII.

In which part or system (blood- or nervous-) of the human body does the disease endanger life?—Inquiry into the mortal symptoms.—The Water-abstraction- or—drainage-theory is opposed by the Poison- (Nerve-poison) theory.

Water-abstraction cannot be the cause of death. In the suddenly fatal cases, there is little or scarcely any vomiting and purging.

IX.

Against the Nerve-poison-theory it has been proved, that beyond the assumed effect on the heart, every other indication of a toxic action is wanting; and that the renal affection cannot be the result of a poison is shown by the sudden disappearance of all morbid symptoms and the immediate restitution of the apparently diseased kidney in its full activity with the restoration of the blood-circulation.

X.

The cholera-germ or poison has its sphere of destructive action in the blood; but this poison cannot be formed in the alimentary duct and then be absorbed into the blood, owing to the cessation of absorption by the intestines.

XI.

The real cause of death must be sought for in the destruction of the blood-corpuscles. All phenomena indicate, that the blood has lost its physiological function of absorbing oxygen; hence: weakness of the heart, stagnation of the circulation, cessation of the oxygenation and change of matter, lowering of the temperatures, inactive kidneys with other morbid and mortal symptoms are the consequence.

XII.

Researches, made in Marseille during the Epidemic in 1884, into the state of the blood in Cholera-patients, has revealed the destruction of the blood-corpuscles in a greater or lesser quantity; and this destruction of the blood was considered as of preponderating importance, because of its constancy. This pathological alteration of the blood was found to be a never failing symptom in all cases—and was hence regarded as a pathognomonic lesion of Cholera.

XIII.

The disease in all its phases is fully accounted for by the destruction of the blood-corpuscles. The nervous symptoms are of a secondary nature. The spasms and especially the weakness of the heart are not the result of a poison, acting on the nerve centres;—but are caused by the absence of oxygen in the blood.

The movements, often observed in a corpse after death from Cholera, cannot be interpreted otherwise than: that the Nervous-system, as the carrier of life, has been deprived of its food—the oxygen, upon the supply of which its existence depends; and thus—in the above cited movements—it still manifests the last remains of the ebbing vitality, after death has already overtaken the blood, from which it received its nourishment.

In a strong wholesome blood we have to look for the power to resist the Cholera-poison—for the Immunity against Cholera.

XIV.

How does a high temperature and moisture (conditions which favour the development of Cholera) act on the blood either directly or indirectly?

External high temperature has no sensible direct effect on the blood of a living human being.

Absorption of water causes the blood-corpuscles to swell, assume a globular form and ultimately to burst, causing the hæmoglobin and potash salts to diffuse in the blood-serum—a pathological phenomenon character-

istic of Cholera. In this spherical form the blood-corpuscles have become soft, lost their capability of absorbing oxygen, and are deprived of the power to resist the Cholera-poison.

XV.

Presence of Common Salt in the blood-serum counteracts this absorption of watery serum by the corpuscles. The salt can be "washed out" of the blood, down to a minimum; this however is tenaciously retained. A further supply of water to the blood thus tends to kill part—and to weaken and soften the remaining greater portion of the blood-corpuscles, and to make them susceptible to the attack of any organic poison or ferment.

XVI.

High temperature and a dry atmosphere produce thirst and incite to drinking. Continuous drinking with a deficient supply of Common Salt, deprives the blood of this latter constituent—causes the corpuscles to be weakened and become susceptible to Cholera-infection.

Drunkards succumb to the disease with a mortality of 90 per cent.

Advent of rain, with a lower temperature lessens the development of susceptibility and thus reduces the number of attacks and the spread of an epidemic.

XVII.

As the susceptibility for Cholera appears to have its seat in the blood, we are naturally induced to direct all our attention to the means for bringing the blood into a condition, which imparts to it the power to resist the Cholera-poison.

XVIII.

It must be evident, that this susceptibility is not so much the result of too great a proportion of water in the blood, as it is the consequence of a deficiency of Sodium Chloride.

Great indifference, if not aversion appears to exist generally about the regular supply of Common Salt to the human system.

Poor people have to seek their food among the cheaper vegetable products, which are rich in potash-salts; these latter deprive however the blood of its Common Salt; they thus tend to weaken the blood, as indicated above; and with abnormal drinking and a deficient supply of Salt to the system develop a susceptibility for Cholera and similar diseases.

XIX.

Of still greater importance is the direct effect of free potash-salts in the blood on the action of the heart. Twelve gram. of a potash-salt, which can be taken into the stomach short of causing sickness—have no deleterious effect on the circulation; but one-tenth of a gram. injected into the jugular vein of a dog, causes the heart to cease beating.

Instead now of injecting the potash-salt direct into the blood, it is set free and is diffused in the serum by the destruction of the blood-corpuscles, causing the various pathological phenomena, as indicated above.

If the Reader has followed the above synopsis so far and not gained sufficient interest in the subject, to make himself acquainted with the whole contents of the book by sacrificing two hours of his time—then all further efforts, to incite him to a perusal of the work, will be in vain.

B.

It is most instructive to read, by the side of the theory of Cholera, as advanced in the preceding pages—not only the latest attempts at combating the disease, and the views entertained about the cause of the outbreak and spread of this plague—but also the records of the researches into the true nature of Cholera, made during the earlier part of this century, when the disease first forced itself on the attention of the inhabitants of India and of Europe. On all sides can we find confirmation of the view, that the disease consists primarily in the destruction of the blood-corpuscles, followed by all the symptoms so characteristic of Cholera, viz.: deficient oxygenation of the blood, and a consequent difficulty of breathing; failure of the heart's action and appearance of spasms in the extremities—both resulting from a deficiency of oxygen in the blood;* almost complete stagnation of the blood-circulation, and as a consequence of this: diminished oxydation and change of matter with a lowering of the temperature; inaction of the kidneys, with accumulation of effete nitrogenous compounds in the blood.

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* Dr. C. Schmidt—Characteristik der Epidemischen Cholera. Leipzig, 1857.—found that the amount of Oxygen in Cholera blood was about one-half of that in healthy blood.

Among the many able records of observations, for which Cholera in India has given an opportunity—none is more interesting than the report, which Mr. Scot drew up for the Madras Medical Board—"a work not often seen"—as cited by Dr. Hawkins (pp. 55 to 75), and from which the following few extracts will serve our purpose:

"This formidable disease does not appear to be attended by any premonitory symptoms, which can be regarded as being at all peculiar to it; on the contrary, we may safely assert that it is of sudden invasion."

"The pulse, from the first, is small, weak and accelerated; and after a certain interval . . . . it sinks so suddenly as to be speedily lost in all the external parts. . . . . Little or no urine, bile, or saliva is secreted. . . . . The respiration is oppressed, generally slow; and the breath is deficient in heat."

"If blood be drawn, it is always dark or almost black, very thick, ropy and generally of slow and difficult effusion."

"During all this mortal struggle and commotion in the body, the mind remains clear, and its functions undisturbed almost to the last moments of existence"—which we take as evidence, that the central nervous system is not directly affected by the Cholera-poison.

Mr. Scot then refers to the variety of symptoms in different epidemics, among them finally to "the worst of all"—as already cited above—in which: "a mortal coldness, with arrest of the circulation comes on from the beginning, and the patient dies without a struggle."

It may be safely assumed, that in such suddenly fatal cases, the individual predisposition is so great, so developed—the blood is so rapidly and extensively destroyed, as to deprive the organism of every power of reacting against the attack.

Dr. Hawkins cites a very instructive case as related by Dr. Sokolov in Orenburg, which illustrates the retention of life in the nervous system, after the patient had already been declared dead, owing to the cessation of breathing and of the heart's beating. ". . . . warm friction, spirituous drinks and even the hot bath, were resorted to, to restore the temperature and bring back the pulse. An unsuccessful attempt was, in the last place made, to draw blood from a vein;"—evidently with the view of assisting the restoration of the blood circulation—"and soon afterwards the man expired. Twenty minutes after his last breath" (when the blood was already dead), "and when the corpse had been already washed and dressed, it was affected all at once with frightful movements. These spasms continued with intervals for ten minutes, becoming in the end faint and rare" . . . . and may be considered as the last death struggle of the nervous system—the extinction of the last spark of life.

As throwing doubt upon the generally accepted idea, that Cholera is primarily or essentially a disease of the digestive and intestinal canal, it deserves to be repeated here what Dr. Keir states in relation to the appearance after death as observed in Moscow (Dr. Hawkins, pp. 293, 4):

"Excepting in this case"—just described—"which was evidently one of congestion, and not of inflammation, I saw nothing in the morbid appearances from which a conclusion could be drawn, that inflammation was a very general morbid change in the alimentary canal, or a common cause of death. . . . . Both, stomach and bowels were frequently of a paler colour than natural, both on the outer and inner surface; but neither thickening nor condensation from inflammation, nor ulceration, destruction of substance, nor abscess, appeared in any of the dissections at which I was present."

Whilst the alimentary duct shows no definite pathognomonic lesion—no doubt or uncertainty, however, can and does exist as to the diseased condition of the blood. In every instance, the blood is found to be altered in its physical character; and even when evacuation and vomiting were absent, when the serum had not lost water, at least to any considerable extent—still the blood more or less ceased to circulate and to fulfil its physiological functions: thus proving incontestably, that in the destruction of the blood consists primarily the true nature of Cholera.

Whatever symptoms, other than those not directly referable to this morbid condition of the blood—such as the degeneration of internal organs or lesions of various kinds, as also the appearance of the body after death, must be ascribed to the constitutional idiosyncrasy of the patient;—since all these symptoms and appearances are present or absent, or vary, according to the state of the organism preceding the attack.

The importance of the individual predisposition as a factor in the development of the disease and of the pathognomonic bearing of the condition of the blood in Cholera, found an early acknowledgment in a letter from Moscow (written by Mr. R. Herrmann to Dr. Todd, of Brighton —as reported in the "Medico-Chirurgical Review," July, 1831, p. 285—and cited in an appendix by Dr. Hawkins, p. 242). Mr. Herrmann states: that the disease can only be developed "under a certain predisposition of the constitution. It appears that in Moscow," —as it was found in Hamburg during the last epidemic—"three individuals, out of one hundred, possessed this susceptibility for the disease."

Mr. Herrmann includes in his enumeration of the proximate causes of the symptoms—"a degeneration of the blood, which, when

arrived to a certain height, terminates the life of the patient by impeded circulation."

This is unequivocal language, which fully agrees with the views of the importance of the individual Immunity and of the nature of the disease, as advanced in these pages.

The Hamburg Epidemic of 1892 has afforded an opportunity of extensive researches, inquiries and experiments, recorded in a great number of publications; some of a very elaborate and imposing character; but their perusal can only confirm the theory of Cholera and the several contentions herein maintained.

Most of the writers approach their subject with the settled conviction that Koch's comma-bacillus is not only and unquestionably the "causative-agent" in the production of Cholera—but also, that it is the only reliable diagnostic indication for deciding the nature of an attack; although the evidence is rather contradictory.

Dr. Rumpel* confesses, that no doubt can be entertained ". . . . that in all the stages of Cholera-asiatica, it can happen, that during one day Bacilli can be found, whilst on the following day they are absent. Even with employment of the most approved and delicate Pepton-water-process, frequent failures resulted, which could not possibly be ascribed to the want of skill on the part of the manipulator or the imperfection of the method used." Dr. R. sums up by stating (in spread type): "that the large number of bacilli found in the dejecta, was by no means an indication of the severity of the case." In other words: the latter depended on the individual predisposition.

He further reports of having found bacilli in the dejecta of four healthy people, who had no diarrhœa, no vomiting nor any signs of any ailment; and then relates the case of some sufferers from Cholerine, in whose evacuations also Comma-bacilli were found. It seems strange, why these cases were diagnosed as Cholerine; since Koch's disciples lay special stress on the fact, that any ailment, which shows the Comma-bacillus in the dejecta, is true Cholera.

In the volume issued by the Imperial Board of Health† (p. 3), we find, that the first cases in Hamburg, although all clinical symptoms pointed

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* Die bakteriologischen Befunde der Cholera im Jahre 1892. (Jahrbücher der Hamburg. Staats-kranken-anstalten. Band III.)

† Arbeiten aus dem Kaiserlichen Gesundheits-amte. 10 Band. 1 Heft.—Die Cholera in Hamburg.

to Cholera, and the ultimate issue and future evidence proved it to be so, yet—owing to the absence of Koch's Comma-bacillus—the cases were declared not to be Cholera-asiatica.

At page 148 (Appendix of the same volume) is reported an instance where:

"In a family of ten persons, two were attacked. The dejecta of the other eight were found to contain the Comma-bacillus; three of these had loose, and one had firm evacuations. The four others were free from any suspicious symptoms. The presence of the bacilli in this instance entitles us to assume that during a Cholera-epidemic a far greater number of people are, for the time being, invaded by the Cholera-vibrio, than there are cases of illness."

This admission of the individual insusceptibility for the disease seems to be reluctantly and tardily made—although not only this, but other instances not in harmony with Dr. Koch's theory and apparently anomalous, find an explanation in, and support the theory: that individual susceptibility is the chief factor for the production of Cholera.

When Dr. Rumpel says (p. 7): "At all events, our observations justify the practically important conclusion, that, when Diarrhœa and Vomiting have lasted for several days accompanied by Comma-bacilli in the dejecta, a favourable prognosis can be made" (the original in spread type)—it is left to the reader to bring this in harmony with Koch's bacillus-theory—according to which the dangerous and ubiquitous microbe should make us exclaim:—Touch nothing; be suspicious of everything and everybody.

It deserves repeating here, how Dr. J. A. Gläser* characterises the bacteriological side of the Cholera question (p. 44):

"Die Bakteriologie, welche droht, die ganze Medicin zu überwuchern, ist eine Specialität im übelsten Sinne des Wortes; mit engem Geschichtskreis, Voreingenommenheit, in geistiger Knechtschaft des Einen, und von der äussersten Ueberhebung gegen alle Nicht-Bakteriologen."

Dr. Gläser in the same volume meets the assumption, that the sudden and extensive outbreak of Cholera in Hamburg, in 1892, was owing to the dessimination of poisoned water by the Water-works, with the following facts:

"1. We have had severe Cholera-epidemics in Hamburg—previous to the establishment of the Water-works.

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* Dr. J. A. Gläser: Die Ueberhebung des Herrn Robert Koch. Hamburg, 1894.

"In 1831-32 there were 1,971 deaths in 146,000 inhabitants, when drinking-water was obtained from wells spread over the various parts of the town and suburbs; and in 1848 there were 1,674 deaths in 170,000 inhabitants, with an 'explosive' distribution of the disease; both were comparatively more fatal than the epidemic of 1892.

"2. We had a severe epidemic, without the presence of any Comma-bacillus being discovered in the Elbe or in the distributing pipes of the Water-works. (See below.)

"3. We have had Bacilli in the Elbe and in the pipes of the waterworks, from which all the inhabitants obtained their drinking water—yet for many weeks we had no Cholera and at the end only a slight epidemic."

This fact (2) is supported by a statement in the report of the Imp. Board of Health (p. 35).

"With reference to this question (the spread of the disease through the Hamburg Water-works) it is only fair to admit, that the specific disease-producing-germ could not be discovered. Only towards the end of September, when the newly established provisional hygienic Institute commenced its labours . . . . were endeavours made to find the bacillus in Elbe- and in service-water. In no instance was it possible to discover the Cholera-microbe."

When after this honest admission, on so high an authority, an attempt is made to ascribe the failure in finding the bacillus, to inexperience and want of skill—it has only the effect of placing the bacteriological science in its worst light and may bring down upon it our contempt.

Extending our inquiry now into the results obtained in the treatment of the disease and the phenomena accompanying it, it may be well to refer first to the question of the acquisition of an Immunity, based upon the assumed effect on the system of a recovery from an attack.

In the report of the Imp. Board of Health we meet with the following statement (p. 80):

"With regard to the question of an acquired Immunity after recovery from an attack of Cholera, we have been enabled to confirm during the time from the 1st of October to the middle of November (the end of the epidemic) the previously made observation, that during the same epidemic the same person can be repeatedly attacked."

This is a well-known phenomenon confirmed by many observers, and should at once direct our attention to the futility of imparting immunity against Cholera by vaccination. In fact the general tendency seems to be, to class Cholera and allied diseases in the same category with the

eruptive fevers; certainly, showing a great disregard of the true nature of these two classes of diseases. In the one class we have, as in variola, &c., a form of disorder, which points to the nervous system as the principal seat of the affection, with the tendency to expel the diseased products chiefly by way of the skin and the internal lining membrane;—in the other, as in cholera, &c., we have a malady which primarily affects the blood, the diseased matter being excreted through the intestinal canal.

By means of vaccination we change the vital character of the nervous system—but do not directly affect the blood. Hence the attempt made by Haffkine, to impart Immunity against Cholera by Vaccination, must fail —as is confirmed by the latest reports from India, where an experiment on a comparatively extensive scale has been attempted.

In lieu of Vaccination—the Serum-treatment has been attempted against Cholera; without any decided result. On this question, it is interesting to learn, what Dr. Aronson (who is consideredan authority) has given as his opinion (pp. 33, 36):

"I must mention here, that according to the observations of Metschnikoff, the blood-serum of persons, who have not suffered from Cholera, possesses a certain protecting-power; and that on the other hand the blood of patients, who have passed through a Cholera attack, does not possess the high value of Immunification so often assumed." . . . . "Contrary to the earlier experiments of Brieger und Wassermann and of Klemperer—the later experiments have invariably shown, that a sure Immunification against an attack cannot be achieved either by a modified bacillus-poison, or by serum." . . . . "We must hence declare the anticipations, at first entertained—if not to cure—at least to protect human beings against Cholera by means of active serum—disappointing."

Even, if not the numerical importance, which the ninety-seven per cent. of the population, who in the Hamburg Epidemic resisted the Cholera-germ, as against the three per cent., who suffered an attack, impress upon us, to direct our chief attention to the individual natural Immunity—we are almost forced to it, in our attempt at explaining the incongruities, discrepancies and contradictions which meet us on all sides when wading through the flood of works on Cholera. And impressed with this idea, it almost seems inexplicable, that this factor, so step-motherly referred to, should not have had more attention and more investigation directed to it; since in any question of doubt or inexplicability, it mostly affords the only rational interpretation. It is not necessary to cite instances here; they

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* Dr. Hans Aronson. Die Grundlagen und Ansichten der Blut-serum-therapie. Berliner Klinik. Heft 63, 1893.

only present themselves too frequently when perusing any dissertation on the Cholera question. The search for the Comma-bacillus and the inquiry into its vitality and virulence, has so absorbed the energies of the Medical Faculty, that the question of a natural Immunity appears like a vanishing quantity which may be neglected. It will revenge itself.

The results, obtained in the Hamburg Epidemic, have a most signal importance in confirming the theories advanced in these pages; and it is but necessary to quote one or two statements of the physicians, who have reported their experience in the Jahrbücher der Hamb. Staatskranken-anstalten. Dr. C. Sick* opens the subject as follows: "With the spread of the Cholera, ... Dr. Rieder introduced the intravenous injection of a Solution of Common-Salt into our Cholera-therapeutics—as the means, hitherto applied in the treatment of the disease, had given very unsatisfactory results.

With the truly wonderful momentary success of the injection, it was not surprising that it should find immediate application on an extensive scale. It was effected with the usual physiological Common-Salt-solution prepared with sterilised water. An addition of Sodium-sulphate as recommended by Hayem, gave no better results and was soon discontinued. Also other medicinal additions were tried, such as Thymol, Peroxyde of Hydrogen, without being more effective, and hence were discontinued."

Dr. Sick then describes the apparatus employed and the whole procedure; and refers to the wonderful, but unfortunately in many cases only temporary effect on the patient. He very significantly adds:

"Although the success was of short duration, we felt at least, that we did not stand quite help-less at the bed-side."

After further describing the varying effects on different patients, which often necessitated several repetitions of the injections, he asks the question:

"What are the effects of an injection of a Common-Salt-solution on Cholera?"

"It is evident from the first that it cannot cure; that it is only a means of saving the patient's life." In other words—and in accordance with the views stated in the preceding pages—if the blood is not yet in greater part destroyed the Sodium-chloride of the infusion will save the remaining portion of the blood and thus enable life to be maintained. And this can only be effected by the Common-Salt

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* Dr. C. Sick. Die Behandlung der Cholera mit intravenöser Kochsalz-infusion.

—hence the inutility of adding other substances of whatever kind to the injected solution; and—as stated before, if the injection is applied in good time.

In the same Jahrbücher, vol. iii., is an article on the same subject from the pen of Dr. G. Hager,* in which he states :

"Of all the therapeutic means applied in the treatment of Cholera, the Infusion of a Solution of Common-Salt deserves unquestionably special regard; firstly, because it is the only means, which is capable of influencing the disease; secondly, because we can give a scientific explanation of its favourable effect; besides which it is just the remedy to attack the disease in the most critical period."

It is significant however that in the next sentence Dr. Hager declares: it is chiefly by the artificial supply of water, to compensate for the loss of water from the system—which is aimed at and not the supply of Sodium-chloride to the blood. "The well-known 0·6 per cent. solution of Common-Salt was chosen, and the addition of other medicinal substances—Camphor, Sodium-sulphate, which were tried—could not be recommended."

From this statement it is quite evident, that the object was mainly—if not only—to inject water into the circulatory system; and that, among many substances to admix with it—Common-Salt was chosen; as if there could have been a choice. That however Sodium-chloride was the substance, which gave the best results, confirms the contention upheld herein: that the presence of this mineral protects the blood, and is essential to the life of the blood-corpuscles, to assist these in resisting the Cholera-poison.

Suffice it, in conclusion, to affirm that the latest investigations and experiences give support to the view about the true nature of Cholera, as advanced in the preceding pages and, with more than probability, establish the efficiency of the proposed prophylactic: Sodium-chloride, as a means for preventing the disease and thus stamping out this enemy of mankind.

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* Dr. G. Hager. Die Infusion-therapie der Cholera behandelt nach 967 Fällen.

LONDON:
PRINTED BY T. PETTITT AND CO.,
22 AND 23, FRITH STREET, SHAFTESBURY AVENUE,
SOHO, W.