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ON THE MODE OF ACTION OF ALCOHOL IN THE TREATMENT OF DISEASE.

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THE subject to which I propose to direct attention is one which for some time past has excited an unusual amount of professional interest, and has led to some angry discussion. Its importance cannot well be exaggerated, considering the very large quantities in which alcohol has of late years been administered in diseases; and, although the method of treatment has now passed out of the able hands of him who introduced it, it will certainly be continued by many of his pupils and admirers, who have not so large an experience or so well-informed a sense of discrimination. But, whilst impressed with these facts, my present object is not principally to keep up the present controversy, but to discuss its merits on scientific grounds, and to remove it further from the domain of hypothesis and empiricism by the aid of the additional scientific information which has been recently obtained. I wish to show what is the true action of alcohol, and what are the general conditions of system to which it is fitted, rather than to discuss minutely the specific diseases in which it may be employed. The same conditions exist in some stages of many diseases; and hence it is better to confine our attention to the separate indications for its use, than to regard the whole phenomena of any disease as an unity, to be treated on an uniform plan. The indications being given, it will be easy to specify the diseases and stages of disease to which alcohol is suitable.

In adducing the proofs of the action of alcohol in diseases to which it is suitable, I presume that we are entitled to cite its action in health; for, whilst the *degree* of action in the former may be different from that in the latter, the *direction* of its action must be the same in both. The indications for its use in disease can never be opposed to its indications in health; but tolerance of its action may be very different in the two conditions. This is an important consideration; for whilst we have much proof of its action in health, we have very little indeed in disease. At present we seek only for its mode, and not its degree of action.

The knowledge of the action of alcohol in health may be sought from two sources: the facts readily cognisant to the senses, and scientific research. The former source of information is perhaps more valuable in this than in any similar inquiry; for the universal employment of alcohols and their decided effects render them objects of popular observation.

FACTS READILY COGNISANT TO THE UNAIDED SENSES.

The Brain.—Alcohols, in moderate quantity, are popularly known to excite the spirits, and to quicken certain qualities of the mind, but to lessen the power of concentration and the clearness of thought; and, when taken in larger quantities, to disturb the harmony of the mental actions, so as to render the person furious and ungovernable, to lessen the power of perception and sensibility, and ultimately to produce coma.

The Skin and Heart.—Alcohols make the hands and face red, hot, and swollen, and increase the force of the heart's action. The skin is commonly dry as well as hot.

Heat.—They yield a pleasant warmth to the stomach and alimentary canal, and the more so when the skin is cold.

The Muscles.—The muscular force seems at first sometimes to be increased, for a man in his fury can exert unwonted strength; but this is due to violent effort of the will, and commonly there is less disposition to move, and less power of co-ordinating the muscles; whilst relaxation of the features exists, and ultimately there is inability to move.

Sexual desire.—Shakespeare, in *Macbeth*, tells us that drink does especially provoke three things. "Marry, sir, nose-painting, sleep, and urine. Lechery, sir, it provokes and unprovokes; it provokes the desire, but it takes away the performance." The latter effect is due to the state of the muscular system, and the statement is doubtless true.

The Kidneys.—In some persons there is diuresis, whether

from increased secretion of urine or from lessened power of the sphincter.

The Lungs.—The breathing in approaching coma is feeble, laboured, or irregular.

These effects are temporary, and endure two or three hours ; and after the excitement there are, in very varying degrees, depression of the spirits and general lassitude, mental prostration, dry furred tongue, unpleasant taste, headache, derangement of digestion, and loss of appetite. Soda-water and brandy in the morning are as refreshing to some persons after, as the wine or spirit was pleasant during, the debauch.

Persons vary very much as to the amount of alcohol which they can take, and as to its effect upon the skin and the kidneys ; but, as a rule, one who perspires and passes urine freely can take the larger quantity. A degree of training is also necessary, so that persons become accustomed to the use of alcohol—that is to say, they gain some power of adapting the system to its presence, or of rapidly expelling it. Alcohol-drinkers in excess are known to be unhealthy, and not equal to others in mental or physical power. They also suffer from loss of appetite, deficient assimilation, and local effects on the brain, stomach, liver, and kidneys. Ale-drinkers are more liable to inflammation than spirit-drinkers.

Such are popular observations.

In a prolonged inquiry upon myself and another, we took the alcohols in moderate quantity, duly diluted, on an empty stomach, in the morning, and during rest ; and we noticed most carefully the general effects, and the moment of their occurrence. The parts of the system influenced by the alcohols, and the order of the occurrence of the symptoms, were as follows :—

1. The heart, doubtless from the local action of the alcohol.

2. The brain, also from local action, as shown by the consciousness, mental and sensual perceptions.

3. The cerebro-spinal tract, as shown by the muscular system ; and the reflex function of the spinal cord.

4. The respiratory tract.

5. The sympathetic system ; but as it is not possible to show the moment when the secretion of urine, for example, is interfered with, it may be that this should have had an earlier place in this order of sequence.

The details of these actions and the period of their occurrence may be thus epitomized, it being borne in mind that the experiments were made in the morning during fasting :—

(a) In from two to eight minutes there was a sensation of fulness at the crown and the back of the head, or at the temples, according to the kind of spirit taken. This was due, doubtless, in great part to the increased force of the heart.

(b) In from three to seven minutes the mind was disturbed. Consciousness, the power of fixing the attention, the perception of light, and, we believe, of sound also, were lessened; the power of directing and co-ordinating the muscles was also lessened, whilst there was a very marked, peculiar, continuous purring or thrilling, and not unpleasant sensation, passing from above downwards, through the whole system. This latter symptom was the most pronounced in from fifteen to forty minutes, and continued, without much variation, during twenty to thirty minutes. After this period the whole effect recorded under this head diminished, and oftentimes suddenly, as was shown by the increased perception of light, as if a veil had fallen from the eyes, and by increased consciousness; but nevertheless the last power to be *completely* regained, was consciousness.

(c) The increase in the action of the heart set in so soon as three minutes, and continued from thirty to fifty minutes.

(d) Coincident with the increase of the heart's action was a sense of dryness, heat, and evident fulness or swelling of the exposed parts of the skin, as the hands and face, and, also, a general sensation of heat. This was due to the increased supply of blood to the surface, and the lessened refrigeration of the skin. This increased for a time, and so much so, that, with rum especially, the skin was as harsh and dry as when exposed to an easterly wind. After about twenty to forty minutes, this sensation of heat gave place to one of cold, which was first felt on the most sensitive part of the body in reference to temperature—viz., between the shoulders; and at length, notwithstanding the existence of a suitable degree of atmospheric temperature, it became distressing, and led even to shivering. This was sometimes so marked, and occurred so suddenly, that it gave rise to a shock. It did not correspond with the temperature of the skin, but it was usually co-existent with the cessation of the increase of the heart's action.

(e) The muscular system was influenced in a marked and definite manner. The action on the involuntary muscular fibres of the heart has already been mentioned. The thin layers of voluntary muscle found about the body showed great relaxation. The respiratory muscles acted in a gasping manner, so that there was a pumping and a quick inspiratory effort in the earlier, and a long, feeble expiratory effort in the later

stage. At all periods there was a sense of impediment to respiration. The muscles of the limbs were inactive. There was relaxation of the muscles, and stiffness of the face, forehead, and upper lip, so that the features fell. This state of the muscular system followed the commencement of the effect upon the consciousness, and other functions of the brain, and, also, the excited state of the heart. In reference to its cessation, the power of co-ordinating the muscles was first regained, whilst the buzzing sensation and semi-cataleptic state continued, and the disposition to use the muscles was regained the last of all. There is so close a connexion between the nervous and the muscular systems, and the complete consciousness is so essential in inquiries of this kind, that it is not easy to isolate the effect upon the muscles; but close attention to all the phenomena, the care taken to note them down at the moment of their occurrence, and the long series of experiments which we have made, assure us that muscular tone and power are greatly lessened; that the effect is not identical upon voluntary and upon involuntary muscles, and that it is even identical upon the inspiratory and the expiratory sets of muscles.

(f) The effect upon the mind was also very marked and peculiar, and would have been a valuable study to a psychologist in search of facts. Rum and some other spirits made us very hilarious and talkative in about ten minutes, and during about twenty to twenty-five minutes; so much so, that my friend was altogether a king; but as minutes flew away, so did our joyousness, and little by little we lessened our garrulity, and felt less happy, until at length, having gone down by degrees, we became silent, almost morose, and extremely miserable. Then, indeed, we felt the sorrows of the drunkard's lot, and saw, with a clearness which can only be perceived by such experience, how certain it is that he must again drink the intoxicating draught. Never were the extremes of happiness and misery brought so vividly before us, or seemed to be in such close proximity, as on those occasions, and never did we so deeply commiserate the slavish, miserable, and almost hopeless condition of the poor wretch who has become a victim to this fearful vice.

In addition to the above, we may mention that every mental perception was darkened, and that the dreaminess, which is not an unpleasant feature of intoxication, is a condition in which neither thought nor imagination acquires power. We suspect very greatly the statements of those who profess that fancy is then on her most airy wing, or that thoughts spring forth without the efforts of parturition; and our most charitable reply to such statements would be, that they are all a dream.

6. ACTION OF ALCOHOL.
(g) The effect upon the secretions was very marked; and, in addition to the varying effect upon the urine, it is certain that the secretions of the salivary glands and of the mucous membranes were lessened, as was shown by the dry state of the mouth, and by the sore and dry condition of the tip of the tongue, which was so often present when rum was taken.

(h) The duration of the influence varied somewhat, both with the substances taken (being usually longer with rum, and shorter with gin), and with the season of the year. In the spring time, it passed away within an hour and a half or two hours; but at other times the system continued to be disturbed, and we were depressed during the whole morning.

In a further inquiry which I have recently made in one of our prisons, I found that when a small quantity (half-an-ounce) of alcohol had been given four times a day to prisoners who laboured at the treadwheel, it produced lassitude, thirst, and great diminution in the amount of urine. The prisoners remarked that they felt lazy, and unfit to do their work, and slept more soundly at night.

Thus, the effects of alcohol, as shown by common observation, both of a general and a precise kind, seem to show that—

1. The spirits may be excited, but all the functions of the brain and nervous system are lessened or disturbed. The excitement of the spirits is not the result solely of the action of the brain and nervous system.

2. Muscular power is lessened.

3. The secretions of the salivary glands and mucous membranes, and, perhaps, of other organs, are lessened.

4. The action of the skin is lessened.

5. The action of the heart is increased in force.

6. There is increased sensation of heat, due chiefly to the larger distribution of the blood to the skin, (the organ of sensation of temperature,) and to the diminution of the loss of heat by diminished vaporisation from the skin—a diminution not prevented by an increase in the loss of heat by radiation.

7. The sensation of cold in the reaction seems to be due quite as much to disturbed sensitiveness of the nervous system of the skin, as to a withdrawal of the increase of the supply of blood to the skin; for it was far more severe than the external temperature warranted.

SCIENTIFIC RESEARCHES.

We may now turn to the result of scientific research. The inquirers have been very numerous, but I will select Hammond as their type, because, whilst his results have much corre-

sponded with those of the other observers of his period, they are all liable to the same kinds of objection.

Influence of Alcohols upon the Respiration and the Heat-forming Function.

To chemists we owe the statement, that alcohol aids in the heat-forming function of the body, because it is an hydro-carbon ; and that, as it is transformed in the system, and eliminated as carbonic acid and water, it must yield heat in these transformations. Hammond and all others found that alcohol lessened the quantity of carbonic acid expired ; but no one has pointed out the inconsistency of this statement with the chemical view to which all these observers have given their adhesion—viz., that alcohol is resolved into carbonic acid, which must pass out by the lungs, and thereby increase the evolution of carbon. Lallemand, to whom we shall refer presently, when denying the transformation of the alcohol, says that he does not understand how alcohols lessen the excretion of carbonic acid, but upon this point he had not experimented.

Now see the objections which may be fairly raised to the experiments from which these results have been obtained.

1. Hammond collected the carbonic acid for one minute three times a day, and thence inferred the total quantity for the twenty-four hours. This evil is also found in most other experiments, as those of Prout, Vierordt, Coathupe, Böcker, and others.

2. Hammond assumed that he ordinarily inspired fourteen times a minute in health, and during all his experiments he did the same, and tried to inspire the same quantity as in health. Hence, at the most he could only have sought for the per-centage of the carbonic acid in the expired air, and not the total quantity evolved in a given time ; but the attempt to voluntarily limit the respiration deprives the whole process of value. Prout also sought only for the per-centage amount. Further, Hammond expired *through* a volume of solution of baryta, and thereby placed a weight upon his expiration, which would either prevent the completeness of the act when the expiratory power became feeble at the end of expiration, or would demand in expiration an unusual force, which no man can so measure as to make the result correspond with free expiration.

3. The influence of other food was assumed to be the same from day to day, because the same amount of food was taken, and the same exertion made ; and, moreover, it was supposed to be the same at the three particular minutes at which the carbonic acid was collected ; but this is quite a fallacy, as we

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have shown in the hourly variations in the evolution of carbonic acid. (*Philosophical Transactions*, 1859.) The same admixture of other unknown influences from food, and the same want of knowledge (the knowledge did not then exist) of the natural variation in the amount of carbonic acid evolved at the various hours of the day, and of the variations from day to day, apply also to the experiments of Vierordt, Böcker, Coats-hupe, and other observers. Hence the liability to error in inferring large from very small quantities, and in assuming that conditions are constant whilst they are most variable, lessens vastly the reliability of the results obtained. To this might be added, in reference to Hammond's experiments, the imperfection of his apparatus; for it is quite certain that a tube containing chloride of calcium would not absorb all the vapour from the breath during the act of breathing, and also, that he ought to have appended a desiccator, through which the air should pass after the partially dried air had passed through the solution of baryta.

The results of my experiments have not entirely corresponded with those now referred to; but, having collected the carbonic acid for five or ten minutes at a time every fifteen minutes during the action of the alcohol, with the expiration quite free; having maintained a uniform state of rest, having experimented in the absence of food or any other cause of disturbance; and having taken one moderate dose at each experiment, it is hoped that the nearest approach to the true action of alcohol has been made. Moreover, the number and extent of the experiments far exceed those which all previous observers have recorded. For the description of the method and apparatus employed, as well as the details of the experiments, I must refer to the *Philosophical Transactions* for 1859.

Alcohol, in every dose up to the usual one in taking spirits and water, increased the amount of carbonic acid evolved, but not with the uniformity of a food, nor to a greater average extent than from one-eighth to half a grain per minute. The effect was much more sustained when a small dose, as half an ounce, was repeated every quarter of an hour. Prout, and all observers, have noticed the want of precise uniformity in the action of alcohol.

Rum increased the carbonic acid somewhat more, and sometimes much more. This spirit is coloured with burnt sugar; and we have proved that sugar very largely increases the evolution of carbonic acid, but the cause of the increase has not yet been established.

Whiskey varied in its action according to the sample.

Brandy and gin (both good, the former foreign, and the latter unsweetened) lessened the quantity of carbonic acid evolved, to a moderate extent generally, but sometimes gin caused great depression.

The duration of this action was from one to two hours.

The volatile oils and ethers, which give character to the various wines and spirits, always, when inhaled, lessened the quantity of carbonic acid and vapour exhaled; and this was the greatest when the aromas were the best—viz., in old and fine wines and spirits. This result was without an exception. The effect of fusel oil, and of other unknown compounds which cause headache, was not separately determined.

With all these substances there was variation in the effect, both in the same and in different persons; and we characterised them as disturbers of the system.

Ales always increased the amount of carbonic acid evolved, to the average degree of a half to one grain per minute, and through a duration of two hours. They contain, besides alcohol, sugar, nitrogenous matters, and volatile aromas; and to the former two this effect must be attributed.

Rum and milk had a very similar, but greater and more sustained, action.

Hence I venture to affirm that alcohol, as a general stimulant, slightly increases the vital actions of respiration; that gluten and sugar do so more largely; and that the aromas and probably the fusel oil and other injurious ingredients of bad spirit lessen these changes.

Action of Alcohols on the Flesh-forming or Nitrogenous Process. I do not stop to show that the term "flesh-forming" is derived from the supposed action of nitrogenous matter, as the waste of flesh is supposed to be indicated by the evolution of nitrogen; but it can be readily shown that urea may proceed either from the tissues, from the transformed food, or from excess of food, and cannot therefore at present be regarded as indicating one or other separately.

Hammond showed that alcohol greatly lessened the excretion of urea, and in this he is supported by all observers. But mark the attendant circumstances, as showing the cause for this diminution. He says:—"Whilst these experiments were progressing, the healthy action of my system was much disordered. Headache was constant, sleep was disturbed, the skin was hot, pulse full and bounding, averaging 98 per minute; and there was, on two occasions after eating, slight palpitation of the heart. My appetite was capricious; sometimes disgust was created by the mere sight of food, at other

times I ate with a good deal of relish. I think I should have been seriously ill if I had continued the investigation longer."

Hence it is quite certain that, whatever might have been the physiological effects of the alcohol, they were those of disease, and not of health; and that, although he ate sixteen or twenty ounces of meat and other foods proportionally daily, there was most marked disturbance of the assimilative function. With a large dietary he was ill nourished; and hence, with lessened transformation of food there was a lessened amount of urea evolved. This is further proved by a reference to his statement that he gained weight (as confirming his view of the power of alcohols to retard waste); for there was a gradual accumulation of fæces, as was shown by his statement: "This fortunate termination was probably promoted by a diarrhoea of considerable violence, which commenced on the second day after the conclusion of these experiments, and continued forty-eight hours." Moreover, I have proved that the system varies greatly in the amount of fluid which it appropriates; and that, with alcohols taken daily, the amount of urine is lessened, and the system has acquired an increased power to accumulate fluid. This accumulation, like that of fæces, is, however, temporary; and, with elimination of it, all unpleasant symptoms pass away. In our experiments in prisons, we found that in all the four men the quantity of urea evolved was greatly lessened on the first and second days, but on the third day it was restored to the normal amount. During this period of retention, the body would gain weight, quite as great in extent as that proved by Hammond; but this would be no proof of diminished waste of tissue.

It may be properly objected, that the above-mentioned statement of Hammond, as to the influence of the alcohol upon his health, only refers to the two series of experiments in which he ate his ordinary amount, and an excessive amount, of food, and that he found no such results to follow its employment when he ate a deficiency of food. This is true; but it does not affect the conclusion at which he arrives—viz., that the alcohol arrested waste of tissue, because, whilst he had lost weight daily before he took the alcohol, he ceased to do so when alcohol was added to his diet, and at the same time the amount of urea was diminished. Let us for a moment see what value ought to be attached to this statement.

Before the experiment began, on an average of five days, his weight was 225·97 lbs., and the daily weights of the fæces and urine were 6 oz. and 41·29 oz. At the end of the experiment, on the average of five days, he had lost, as compared with the

previous five days, 47 lb. in weight, and the daily weight of his fæces and urine was lessened by 19 oz. and 1.37 oz. The whole question rests upon the fact of there being an arrest of the waste previously going on during the five days before the alcohol was taken, and a positive average gain of .03 lbs. in the weight of a man weighing upwards of fifteen stones, as compared with the weight on the single day immediately preceding the experiment. Is it not absurd to attach any value to so small a change, and particularly when we bear in mind the defects of ordinary balances to weigh 226 lbs., the errors of weighing, and the variation in the amount of excretion remaining within the body? But let us admit it all, and what is it worth? He gained in weight 16 lb. on the average of five days, whilst the retention of fluid per day in the urine during the five days was, on the average, 74 oz., and that of the fæces, 24, or a total retention of excretions of 4.9 oz., from which he ought to have gained more than he did gain. That these excretions were retained, and were subsequently emitted, is proved by the results of his own and of our experiments. Hence, he gained in weight by the temporary retention of urine and fæcal excretion, and not by any increase in the tissue of the body, and the whole supposed value of the experiment and the deductions therefrom is taken away.

Hammond further states, that the perspiration did not appear to be lessened under a temperature of 73° in the shade; but he did not make any experiments in reference to it, and referred only to the evident perspiration. Other experimenters upon man and the lower animals, have found the skin unusually dry and harsh.

To these various scientific researches we will add that of MM. Lallemand, Perrin, and Duroy, who have just shown that, when a moderate dose of alcohol has been taken, either by a man or a dog, the alcohol can be found in the expiration, the perspiration, and the urine, for at least eight hours afterwards. They have not collected the alcohol; but they have shown its presence by its action upon the bichromate of potass in sulphuric acid, and have proved that this action is not produced by the allied substance aldehyde. They affirm, therefore, that alcohol is not transformed in the system, but passes off from the body unchanged; and the fact that alcohol is found unchanged in the brain for a period of seventeen, and, it is said, for thirty-six hours, strengthens their belief. I have carefully repeated their experiments, and have shown, on several public occasions, the reaction of the alcohol in the breath for four hours after an ounce and a half has been taken. In the case of

the skin, M. Lallemand proved the excretion of alcohol, by enclosing an Italian greyhound in a glass case, and passing a current of air over it and through the test; but I have proved its presence in the vapour passing off from so small a part of the body as the arm, and even the hand only, of a man. In repeating this latter experiment, sheet caoutchouc must not be used, neither must the containing bag or vessels be luted with naphtha, nor be employed a second time without having been well cleansed from the alcohol which was left from the former experiment. It will also be more efficiently performed in those persons who perspire freely; for it is highly probable that whilst alcohol may, in all persons, pass out of the body by all the above-mentioned outlets, it will chiefly select that excretion in each individual which is naturally the most free; as, for example, the breath in those who make much exertion, or in cold; the skin in those who perspire freely, and in warm weather; and the kidneys in others. The test is prepared by carefully dissolving one part of bichromate of potash in 300 parts of strong pure sulphuric acid, and it is used by passing the breath through about a drachm of it placed at the bottom of a tube, six or eight inches long. The cherry-red colour is changed to emerald green.

Thus we are led to the following summary of the mode of action of alcohol:—

1. The action of the heart is reinforced, and by it the fulness and freeness of the circulation are maintained, and the blood is carried to the remote parts and to the surface. The tendency to accumulate fluid increases the fulness of the blood-vessels.

2. The action of the skin is lessened, whereby the loss of heat is reduced, the urgent necessity for food and vital transformation is lessened, and the sensation of warmth is increased. The local action upon the stomach and alimentary canal is that of a stimulant, and increases vascular action and warmth. These are the common and general actions of alcohols; but in some persons the skin acts more freely than in others.

3. Alcohol is probably not transformed, and does not increase the production of heat by its own chemical action, but indirectly, as above mentioned, and by a general temporary increase in the vital actions. Its action upon the respiration is not its important action.

4. It interferes with alimentation, and causes the retention of water, and thereby lessens the excretion of urea; and if it lessen muscular waste (which it has not been proved to do), it must be by deranging and lessening vital action. Its power

to lessen the salivary secretion must impede the due digestion of starch. The diminution in the elimination of urea is due in part, as just mentioned, to the diminution in the excretion of urine by the kidneys.

5. It lessens muscular power, and the production of certain secretions.

6. There is no evidence that it increases nervous influence, except the action upon the heart and the elevation of the spirits be regarded as such; whilst there is much evidence that it lessens the nervous power, as shown by the mind and the muscles.

7. It varies the balance of the circulation at the centres and the superficies, and interferes with the production of heat.

8. It has two sets of actions.

9. The system acquires an adapting power more or less easily and perfectly; and hence alcohols differ somewhat in their action in different persons.

10. There are other important elements in ales, wines, and spirits having a different and independent action; so that the aromas of old wines have a conservative influence, and ales directly promote transformation of food.

The dose influences the phenomena of the action of alcohols, but only in degree, although it is common to consider the action to differ in doses which are called moderate and excessive respectively, the former being stimulating, and the latter exhausting. So far as the direct action upon the mind with its intellectual and sensual perceptions, upon the muscles, and upon the respiration, is concerned, we could not perceive any difference in effect but one of degree; but, doubtless, that dose which most powerfully acts upon the system directly will be the most likely, by the disturbance of the functions of the system, to produce indirect effects which will tend towards disease.

For all medicinal and dietetic purposes, I venture to affirm that the dose only affects the degree, and not the direction of the influence.

Having thus established the foregoing facts, I proceed to consider the views of the late Dr. Todd on the therapeutic action of alcohols, as contained in his well-known lectures on that subject, and to see how far they may be supported by the present state of science. His views are based upon the chemical theory that alcohol is transformed within the system, and produces heat, and the following is a summary of his remarks:—

1. Alcohol acts primarily on the nervous system, and, like

other hydrocarbons, but in a greater degree, has great affinity for the nervous system.

2. It acts in two degrees: in one, beneficially, when it augments the generation of nervous power; and in the other injuriously, by deteriorating, impairing, or destroying the nutrition of nerve-matter. In the first degree—when it acts beneficially—there is no smell of alcohol in the breath; but in the latter, or when the dose is too large, the odour is perceptible.

3. There is no true secondary depression of the vital powers, except when the quantity is too large, and then it acts by deranging the digestive function.

4. Alcohol does not in any dose cause inflammation of the lungs, heart, or liver. The brain-symptoms do not shew congestion or inflammation, but a poisoning of the nerve-cells and nerve-fibre.

5. When carefully taken, it upholds the calorifying process, strengthens the action of the heart, and reduces the frequency of the pulse. By upholding the calorifacient process, it prevents oxidation of the nervous and other tissues.

6. It is simply absorbed into the circulatory system; but oil (another hydrocarbon) has a more complicated digestion, and, therefore, alcohol acts more quickly and certainly.

7. The dose should be from two drachms to two ounces, and repeated as frequently as food would be given, and with the same intention—to save the tissues from oxidation. The dose and the frequency should be precisely adhered to.

8. The general use of alcohols shews an instinct in men for them, and in recovery from disease they uphold nervous force, and supply the most assimilable material for combustion. They calm the nervous system and avert delirium.

9. It is very dangerous to withdraw the alcohol; but the signs which would sanction this are referable to deranged digestion, as flatus, eructations, sickness, and dry tongue and mouth, and also the smell in the breath, which implies that the alcohol is passing off unchanged. Coma and delirium from excess of alcohol rather indicate that more alcohol should be given.

Such is a summary of Dr. Todd's views. They chiefly include the belief that alcohol increases nerve-nutrition, strengthens the heart, lessens the rapidity of the circulation, shields the tissues from oxidation, and produces heat; and the sign which measures the necessity for it is the non-existence of the odour in the breath. As to the skin, he merely remarks that, when alcohol is given to a patient who has a hot skin and rapid

pulse, it may look like an illustration of the dogma, "*Similia similibus curantur.*"

In reference to all Dr. Todd's inferences from the supposed transformation of alcohol in the system, we may remark that they are of no value if it be shown that the transformation does not occur; but that alcohol, after remaining in the system for a time, and exerting its action, is ejected still as alcohol. I believe that the latter is almost, if not quite, certain.

I see no grounds whatever for the statement that hydrocarbons have an especial affinity for the nervous system, taking starch and oil as the representatives of this class; and Dr. Todd does not adduce any. Neither has it been in any way proved that alcohols improve the nutrition of the nerve-cell and fibre in any separate and special way, but only by improving the whole nutrition of the body. Indeed, the phenomena of nutrition lead our attention away from mere local actions as independent conditions, and teach us that it is a general and not a local act. All the phenomena attending upon the action of alcohols when taken in quantities which may render the effects noticeable, evince great nervous disturbance; and I cannot but believe that, whilst the nervous system is very principally affected, it is by the opposite of a healthy and nutritive action.

The statement as to the action upon the heart is doubtless correct, as is also that upon the frequency of the pulse; but the latter action is indirect, and probably due to the former, whereby a larger quantity of blood is forwarded at each action of the heart, and the blood is more perfectly distributed to the whole body. A rapid pulse is commonly a small one; and the impulsion of a larger quantity of blood at a time lessens the necessity for the quicker circulation of it.

It is singular that so acute an observer as Dr. Todd should have made so little reference to the action of alcohol upon the skin, and its power to accumulate water in the body and to retard the elimination of urea. But, in reference to the former, I may remark that acetate of ammonia was a most frequent adjunct to his alcoholic treatment, and this might do something to counteract the action of alcohol upon the skin. Moreover, whilst he did not withhold alcohol when the skin was hot and dry, his cases were frequently such as had perspiring skins; and in such instances he remarked upon the diminution in the perspiration during the action of alcohols. It may also be remarked that, Dr. Todd very commonly added chloric ether, and not unfrequently quinine, to his plan of treatment; and hence there were several actions induced, some co-ordinate, and others opposed.

This statement in reference to the absence of alcoholic exhalation from the lungs, in cases of disease in which the alcohol is well borne, is worthy of further investigation; but, on inquiry, I do not find that this fact has been recognised by others. If alcohol pass off untransformed, it is evident that this cannot be true; but if it be true, it is a most valuable guide.

Upon the whole, I do not think that the arguments used by Dr. Todd are now sufficient to establish his theory of the action of alcohols, or to warrant his peculiar plan of administration; but, on the other hand, I think that the practice which he pursued must rest only upon the ground of his personal authority.

It now remains to state the stages and conditions of diseases to which alcohols in various forms seem to be well fitted, the action in health being accepted as a sufficient guide; and it will not be difficult to show that the usual practice of the profession has been based upon truth, however little or much the mode of action may have been understood.

I think that it must be accepted that the essential and direct actions of alcohol as a remedial agent are—the increase of the force of the heart's action, the local stimulation of the stomach, and the diminution in the action of the skin; whilst the most important dependent actions are the retention of urea and fæces, by or with retention of fluid, diminution of certain secretions, and derangement of the assimilative process.

In conditions in which the force of the circulation is too feeble, there must be defective nutrition, innervation, and oxidation of the products of alimentation; for a certain fulness of the blood-vessels is clearly necessary to such brain-phenomena as consciousness, as may be inferred from fainting; to excretion, as may be seen in the increase of urine after ingestion of fluids; to general innervation, as shewn by the sense of *malaise*, which accompanies feeble, and of *bienaise*, which is found with proper heart's action. And a certain frequency with duration of the exposure of the blood in respiration is necessary to the proper interchange of gases; whilst a due amount of action of the heart as well as of respiratory effort is required for the free circulation of the blood through the lungs. Hence, with weakening of the force of the heart, the muscular and nervous forces are weakened, and all vital processes are inadequate to health.

Such a state is shewn in general debility, deficient innervation, or exhaustion from numerous causes, temporary debility from over-exertion or anxiety, convalescence from almost all

diseases, the state of exhaustion in fevers with certain limitations. If in such conditions alcohol be administered in such a manner as not to induce derangement of the system, it is easy to see how Dr. Todd's statement may be verified—viz., that it improves the nutrition of the nerve-structures, and does not produce inflammation; in addition, it may be shown that it will prevent or remove the tendency to local congestion of organs, as the lungs and liver, and the results of such congestions, viz., effusion of fluid, and that it will improve the whole nutritive and vital powers of the body. This is certainly in accord with universal practice, both in this and in former ages; for, while we may appeal to the great mass of the profession in reference to their experience now, we have on record, in the works of Aretæus, an admirable description of the effects of wine in such conditions in his day, which we will transcribe. In the treatment of syncope he remarks:—

“But, if converted into syncope, and this also happens (the powers of life being loosened, the patient being melted in sweat, and all the humours being determined outwardly, the strength and pneuma being also dissolved) we must disregard the delirium, and be upon our guard, lest the patient be resolved into vapours and humidity. Then the only support is wine, to nourish quickly by its substance, and to penetrate everywhere, even to the extremities, to add tone to tone, to rouse the torpid pneuma, to warm that which is cold, brace that which is relaxed, restrain those portions which are flowing outwards. Wine being sweet to the sense of smell, so as to impart pleasure, powerful to confirm the strength for life, and most excellent to soothe the mind in delirium. Wine when drunk accomplishes all these good purposes, for they become composed by the soothing of their minds, are spontaneously nourished to strength, and are inspired with pleasure.”

But we require at least another indication as our guide in the administration of alcohol: viz., the condition of the skin. The regulation of the heat of the body, as well as the due distribution of the volume of the blood to the central and peripheral organs, rests very much with the skin. We know well the great benefit which has resulted in the last stage of fevers, in local inflammations, and in sun-stroke, from the free use of cold water to the skin, although that could cool the skin by contact and radiation only; and from the application in similar conditions of warmer fluids, which, so far as they were of lower temperature than the skin, directly cooled the body, and, so far as they exceeded the temperature of the skin, might tend to restore to it the function of evaporation, and thus in-

directly cool the body. Both these plans are of well-known efficacy; and, although apparently opposed, produce or tend to produce by different methods the same result. Now, although there may be deficiency in the heart's action, if the skin be hot and dry it is manifest that great risk may follow the use of alcohols; and when, as in the sthenic stage of fevers and inflammation, the force of the circulation is increased from the resistance to the current of blood offered by the capillaries in the great inactive external organ of the body, it must tend directly to do injury. Hence it was never the practice to give alcohols in the active and hot stage of fever; but when the condition arrived in which the skin had lost something of its dryness and had become soft, and particularly when it perspired, alcohol became the sheet-anchor of the practitioner. With a perspiring skin, wine and other alcohols could be given profusely; and I once gave six bottles of port wine in forty-eight hours to a female in such a condition occurring in fever. These are the states in cholera and diphtheria in which very large quantities have been administered with the effect of saving life from imminent peril. Such also were the views of the ancients; for Aretæus again writes:—

“But if the period be already come to a crisis, if there be dew on the clavicle and forehead, the extremities cold, the pulse very small and frequent, as if creeping, and feeble in tone, the patient must take a little food, and partake of wine effectually.”

And again:—

“But if much sweat flow, the pulse come to a stop, the voice become sharp, and the breast lose its heat, we are to give as much wine as the patient can drink. For those who are cold, wine is the only hope of life.”

Hence a feeble pulse and an active skin are, and always have been, regarded as the clear indications of the requirement of alcohol; and, as the skin loses its excess of action, the rapidity of the pulse will decline, and its fulness and force increase. This is the most perfectly exemplified in the case of many Europeans, even ladies, residing in India, who find it really impossible to bear up against enervation without the use of some forms of alcohols.

I have before referred to Dr. Todd's practice of giving acetate of ammonia, and may remark that, in cases of fever where the exhaustion had just began, it was always the rule amongst practitioners to give ammonia and not an acid with the cinchona, with or without wine: and no doubt the action of this was to temper the action of the bark and alcohol upon

the skin, so as to prevent a too rapid reduction of the action of the latter organ.

It is however singular, that patients with hot and dry skin should have borne the exhibition of twelve or twenty ounces and even much more, of brandy daily for weeks together; whatever may be the truth as to the mortality or prolonged duration of the disease, which followed its use. We see in health that there is a remarkable variation in the toleration by the system of the action of alcohol; and in certain conditions of disease we know that the toleration is much greater. If Dr. Todd's statement be correct as to the non-emission of the fumes of alcohol by the breath in certain cases in which large quantities have been given, it is quite open to question whether in such cases the alcohol obtained its usual entrance into the circulation. This seems to be the explanation of the similar condition in cholera, where the vital power of absorption is so greatly reduced; and it is quite certain that the body has naturally a power to resist a further introduction of food and water into the blood, but allows it to pass off by the bowel. This is probably the safety-valve provided for such emergencies.

It has fallen to my lot to see cases of subacute inflammation of the lungs, and of the deposit which has succeeded to the inflammation, treated on Dr. Todd's method with alcohol, while the action of the skin was deficient; and I certainly have been impressed with the belief that the progress of such cases towards recovery was greatly retarded. The action of alcohol in restraining the secretion of the saliva and of the mucous membranes did not appear to me in such acute or subacute cases to be of great importance; for, whatever might be the state of the tongue, if the skin were freely acting and other conditions called for the use of alcohol, the alcohol was well borne.

It is impossible to pass over in silence the influence of alcohol in lessening the excretion of urea; for, if it do so simply by causing the retention of fluid in the body, it may be most prejudicial in cases of fever, where the whole safety of the patient seems to depend upon the free elimination of the excessive amount of urea which is then formed. It is only when the amount of urea has naturally fallen with the subsidence of the febrile condition, that alcohol can be administered. But, in any condition in which the amount of urea is lessened by reason of interference with the digestion and transformation of food, it is allowed by all that alcohol is injurious. In this condition it is very likely that the diminu-

tion in the flow of saliva may play a very important part ; for it must greatly lessen the transformation of starch : and the retention of the fæces, with other co-ordinate actions, will explain the temporary condition of the liver and the headaches, which are their constant attendants.

The efficacy of alcohols in delirium and coma has been quoted as a prime argument in favour of recent views. When the delirium is not the result of blood- or brain-disease, but indicates exhaustion, as in delirium tremens, or syncope, or after fright, it is easy to explain that alcohol or opium or bark, by giving force to the heart, and lessening the action of the skin and kidneys, is very likely to cause that condition of fulness of the blood-vessels of the brain, which is necessary to perfect consciousness. In certain forms of coma, the beneficial action of alcohol may be explained by its power to quicken the circulation.

In both of these states, we shall doubtless find that any remedy which acts in the manner now indicated will be equally beneficial with alcohols. While there is so much diversity and apparent opposition in the remedies employed by different practitioners, there can be no doubt that they have in the mode of their action an unity which it is most desirable to discover.

The local action of alcohols upon the stomach does not call for remark ; since the direction of this action is evident and well understood. The statement that alcohol must impede digestion, because a substance placed in it becomes hard, can have no reference to the action of the moderate and diluted doses of alcohol which are generally employed.

The frequency and regularity with which alcohol should be given when it is necessary to prevent exhaustion, have been well stated by Dr. Todd. As the primary action is temporary, and passes away in half-an-hour, the call for it is quickly renewed ; and in case of danger an interval of half-an-hour would be long enough.

As to the dose, I venture to recommend the use of small doses, say half-an-ounce of alcohol, when spirits would be given ; for we have shown that the frequent repetition of a small dose conduces both to a full and a sustained action. It may be well to remember that, as spirits contain from 40 to 70 per cent. of alcohol, sherry and port wines from 17 to 24 per cent., and good ales from 6 to 10 per cent., two ounces of spirit are equal in alcohol to about five or six ounces of wine, and to twelve or sixteen ounces of ale.

In conclusion, I would invite attention to the use of the

aromata of wines, and the saccharine and nitrogenous elements of ales. It is clear that these have an action apart from, and sometimes different from, that of the alcohol; and therefore are fitted for different conditions. The conservative influence of the aromata of wines seems especially to be fitted for the cases of excessive nervous action, in which to reduce this action would conduce to health; whilst in fever it has been remarked that the newer wines, containing little aroma, and more spirit than old wines, have a better action.

It is well known that a quantity of alcohol may be taken in wine, and particularly in good wine, in health, without affecting the sensorium, which could not be borne at all if drunk as spirits and water; a fact due partly to the greater length of time over which the drinking of the wine is extended, and in other part to the opposing effect of the aromata. Aretæus directs that "the wine is to be fragrant and not very astringent."

As sugar largely increases the evolution of carbonic acid, and gluten has a similar action, but less in degree and in rapidity, and as in the latter case at least the carbon could not have proceeded from the gluten, I am led to believe that beers have the power of directly promoting the assimilation of carbon as food. Whether this is due to the quality of a ferment which nitrogenous matters possess, is not here important to discuss; but the combination of alcohol with these principles and with a bitter property, gives the most admirable compound which the world has seen, especially fitted for the cases in which there is general enervation, defective power of assimilation, and active state of the skin, as in the lassitude and exhaustion of many in hot climates.

Hence there are certain cases in which alcohol is chiefly called for, and in which spirits of wine may be given quite as usefully as the ordinary compounds; others, in which the aromata of fine old wines are of great value: and a third class, in which the nitrogenous digestive agent in ales should be added.

I think it would be to the advantage of our patients if, in cases in which we desire the effects of alcohol and not of the other ingredients found in alcohol—viz., the increase in the action of the heart and decrease in the action of the skin—we administered spirits of wine instead of spirits; because, by obtaining it during the first hours of distillation, we may obtain a nearly pure alcohol; and by indicating the specific gravity, we may at all times know the true amount of the agent which we employ. Alcohol varies very greatly in flavour and in degrees of purity; and it commonly happens that the

kind which is used in the manufacture of spirits is that which passes off in the later hours of distillation, and contains much fusel oil and free acid, which are very injurious to health. Moreover, as there is a clear difference in the actions of alcohol and of fine old brandy, we have in alcohol an agent which will effect the two purposes above mentioned, and will at the same time somewhat support the respiratory process.

16, *Queen Anne Street, W.*, January 1861.

