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Thesis on the Physiological and
Therapeutic action of Alcohol
by
Christopher Crawford M.B. Ch. 1874



Hamilton, April 30th 187

I the undersigned hereby certify that
the following Thesis has been com-
posed by myself without assistance
C. Crawford M.

I have chosen for my thesis the "Physiological and Therapeutic action of Alcohol" - the question *vera* of modern times. In looking about for a subject I was desirous, as a general practitioner, to choose one which would be of practical interest, the preparation of a thesis upon which would not merely serve the immediate object of the dissertation but would by the study of the matter itself, its bearings increase the practical knowledge of the writer and assist him in grappling with the problems of disease which daily come in his way. Alcohol is prescribed every day both as a medicine and as an article of diet and considering the amount of good or evil which may flow from its use according as it is legitimately and scientifically used or the reverse I thought it might not be unprofitable for myself if I tried to ascertain the state of our knowledge on the subject. I have read all the books and articles on alcohol on which I could lay my

hands and to these sources I must confess
self indebted for the materials of the greater
part of the following dissertation in which
however I have included the results of my own per-
sonal experience, which though small and
limited has not been devoid of interest and
instruction to myself and will not, I hope
be beneath the notice of the Medical Faculty
the University of Edinburgh. Whether my
treatment of the subject be satisfactory to the
or not, I must confess the benefit I have
derived from the study of the subject, as it
is a matter upon which all practitioners of
our art should have clear and particular
so far as physiological & clinical knowledge
will guide us. I have only taken up a few of the
more prominent points as the space required
for a full discussion of all the questions in-
volved would have been unlimited. The points
I have principally discussed are the influence
of alcohol on the Nervous System, the Circulation

the temperature of the body, the excretion of Carbon and Nitrogen, the destruction of alcohol in the body, its action in disease and as a diuretic agent.

Nervous System. It is by its action on the Nervous System that alcohol produces most of its well known symptoms. Lallemand, Penin and Dury in their experiments related in the well known work, *De rôle de l'alcool et des anesthésiques dans l'organisme* (p. 231) found that alcohol had a special affinity for the nervous centres. When alcohol was taken by the stomach in large doses and the animal killed, the alcohol was found in greatest quantity in liver, then in the ~~brain~~ cerebrospinal nervous substance and then in the blood and tissues. The proportional division of the alcohol in the principal parts of the organism is represented at an average after their experiments by the following figures:-
 Blood - 1 Cerebral Matter 1.34 Hepatic parenchyma

The muscular + cellular tissue retains a quantity of alcohol very inferior to that which is found in the blood. On the other hand when alcohol was injected into the veins it spread through the tissues just as when injected by the stomach but it accumulates more in the nervous centres. The new proportion is indicated by the following figures Blood-1. Cerebral Matter-3. Liver 1.75.

Dr. Schulz (Archiv f. Heilkunde) contradicts this statement and says that the largest portion of any injected dose of alcohol is always in the blood and not in the nervous centres and liver.

Alcohol is usually said to stimulate the Nervous system. Austin draws a clear distinction between its stimulant and narcotic action. He comes to the distinct conclusion that the symptoms which are so commonly described as evidence of excitement dependant on a stimulation

of the nervous system preliminary to the occurrence of Narcosis are in reality an essential part of the Narcotic - that is the paralytic phenomena. A preanesthetic stage may indeed be observed except in cases of very rapid saturation of the blood with alcohol but it is not marked by such symptoms as are now referred to - it is already at an end when they appear. (Stimulants and Narcotics by Austin p. 415). This preanesthetic stage he calls true alcoholic stimulation.

Symptoms of Narcotic action. The first stage of Narcotic action is called by Richardson "the stage of vascular excitement and exhaustion" (Cantor Lecture on Alcohol, Macmillan & Co 1878 - p. 55) It is caused by paralysis of the vasomotor nerves. The face becomes flushed, the eye brilliant, the circulation and respiration are accelerated, the temperature (at least of the surface) becomes increased, strength is augmented, the mental faculties become excited

intelligence is stimulated, ideas crowd, words
and gestures become animated.

The next stage is called by Richardson
"the stage of excitement & exhaustion of the
spinal cord with muscular perturbation".
All the purely automatic acts which we
are accustomed to perform independent
of the will and even of consciousness, become
difficult and require for their performance
to have the mind specially directed to them.
Then the coordinative power over mus-
cular movements begins to fail and the mus-
cular power itself lessens. Locomotion
impaired - there is the peculiar staggering
characteristic of metformin. The hands can
not seize what they want except in an un-
ward way. Richardson says that the mus-
cles of the lower lip in the human subject
usually fail first of all, then the muscles of
the lower limbs and it is worthy of remark
that the extensor muscles give way ear-

than the flexors (ibid. p. 34). The tongue becomes embarrassed

The next stage is that of "imbalanced reason, any power and of volition" where the central centres become influenced. Intelligence becomes obscured, ideas meagre, reason is dethroned and the emotional, passionate, animal or lower part of man's nature comes into view. "In vino veritas" Each one reveals his weakness, which in sobriety he has sense enough to conceal. The coward shows himself more craven, the angry man breaks out into passion, strikes and bites, the amorous man sighs and kisses, the melancholy man sheds tears and speaks of pity and death. His acts are extravagant and he may even descend to violence and crime. This delirium of action is sometimes provoked at this period by sensual illusions or even true hallucinations. General and special

sensibility is also perverted and ~~strange~~
there are noises in the ears and mist before
the eyes. At this period the afflux
of blood to the brain is shown by the redness
of the face, the pulsation of the arteries
of the neck, swelling of the jugulars,
dilatation of the pupils and commencing
convulsions. The fourth stage
that of "complete collapse of nervous
power" or as we may call it Quiescence
or annullation. Sensation and motion
are completely lost, the body lies like a
beast of intelligence extinct and senseless.
pupils become dilated, temperature of
the eye is glazing and the individual is
said to be "dead drunk". While he is in
this condition the most painful operations
may be performed as if he were under the
influence of chloroform or ether. Profound
sleep lasts for some time 16-24-36
hours. An awakening of drunkenness

has not been intense he soon recovers; if intense he suffers for some time from malaise, pain in head and gastric symptoms such as anorexia, coated tongue, thirst and vomiting, sometimes urticaria.

The idea of phenomena is thus described by Austin (London Med Review Feb. + March 1862) Alcohol or Narcotism is equivalent to paralysis, every one of its symptoms being a consequence direct or remote of palsy of some portion of the nervous system. The Sympathetic suffers first as indicated by flushing and great heat of surface which leads quickly to sweating. The cerebral hemispheres follow next or rather these and a portion of the Medulla oblongata are simultaneously affected - there may be a kind of involuntary memory of past events or perception of time and space may be impaired - the reasoning faculty inter-

find with - then progressive obliteration
down to entire unconsciousness. The
first indications of paralysis of the med
oblongata are exhibited by the Musculat
ures oculi, by the Muscles of the tongue
and the sensitive branches of the fifth
pair which supply the lips. Spinal
paralysis now commences (or in
cases earlier) the posterior limbs being
first affected. Superficial sensibility
and the coordinative power are
what earlier affected than volun
tary motion. Then we have coma &
palsy of the respiratory Muscles
caused by profound affection of
Medulla oblongata.

The heart usually beats for a few minutes
after respiration has ceased a fact well
illustrated by Perrin & during Orentum as
it was peculiar to alcoholic poisoning
It is not so as I have seen the same

they occur in death from other causes such as Puerperal Eclampsia and death from Haemoptyses. In fact I believe that in all cases the heart is ultimately moribund.

Death sometimes comes on very rapidly when a large quantity has been swallowed - apoplectic form. Rapid death is also furnished by exposure to cold, lively emotion, anger &c. The powerful effect of cold on the vitality of drunken persons is well known and has been too often verified in the experience of Arctic expeditions and is well exemplified in Richardson's experiment of putting a warm blooded animal under the influence of alcohol and another not so in a room with a temperature of 10° below freezing point. Both sleep, but the drunken one sleeps to die, the other sleeps more deeply than is natural and lives so long as the store of

food it is charged with continues to
port life. Within this brief time it awakes
unimpaired when conveyed to a warm
air. (Cantor Lecture p. 71).

3 Death is sometimes sudden as if the
individual were struck by lightning
and is due to sudden paralysis of the
central functions from shock.

Phenomena vary according to vol. &
virility, nature of drink and other
causes not well known. If drunkenness
does not always reflect the character
and habitual preoccupations, it is
in virtue of conditions which occur
as varying forms, being gay for one
and sad for another &c. The drunkenness
of wine is gay & noisy, that of
is more profound and durable, some-
times furious and frequently accompan-
ied by entire stupor. Intoxication from
sparkling wine is light & festive,

from her is dull and overwhelming.

Women and children are more susceptible to it than men owing to their more sensitive nervous system. A well known fact is that a change from the warm atmosphere of a room to the cold external atmosphere aggravates intoxication. M. Rochoux (Dict. de Med. vol. VIII, 2^d Edition p. 224) thinks that this is due to the sudden arrest of transpiration which returns in the blood the intoxicating particles which were escaping in a continuous manner. I have no doubt it is also due to the tendency to coma when exposure to a cold atmosphere while under the influence of liquor always produces. When the secretory organs are very active the tendency to drunkenness is lessened and doubtless this helps to explain the difference in susceptibility to alcohol which we find to exist among different

individuals. Persons affected with
depression or Hysteria can take alcohol
almost with impunity. In the
des Hôpitaux No. 113. 1858 p. 40
narrates a case by M. Pidoux of
man afflicted with Poly depression who
swallowed every day for a week a
of brandy without being in the least
by it or even becoming gay. In this
it was doubtless resorted to rapidly
the kidney, & from the urine the great
part of it might have been obtained.

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Percy (Dict des Sciences Médicales
vol. xxvi p. 249) describes a con-
vulsive form of drunkenness in which
there is excessive agitation and fur-
rage with frightful convulsions.
is haggard, menacing, stutters, hea-
ters, shouts, his limbs are twisted
hundred fashions with extror-
dinary force & are titanically stiff. Con-

ness is abolished and sensibility is diminished or extinct. The face is pale and the pupil without movement. Erythema observed by Percy Reverend.

In intoxication Anesthetics (Stimulants & Narcotics p. 410) differentiates various forms of Sympathetic paralysis, some of which have already been mentioned. (1) Flushing of the face a phenomenon which marks the commencement of the narcotic stage. (2) Excessive rapidity irregularity or preternatural slowness of the circulation. (3) Production of Sugar in the Liver. Harley by the injection of alcohol in considerable concentration into the portal vein produced sugar. Anesthetics after verifying Harley's observation tried to produce the same thing on himself by taking 2-4 ounces of Sp. Vin. Rect at 9 p.m. and carefully testing for sugar three hours later and also

at 9 A. M. and 9 P. M. on the following
but could find no sugar present. He
thinks it is caused by a strong local
on the Sympathetic nerves in the
drelf or else a very profound degree
of poisoning of the whole nervous
and in either case he cannot do
the influential cause is the par
agent. (4) State of the pupil - In
earlier stages of alcoholic intoxication
the pupil is generally contracted, but
in the comatose stage it is nearly always
dilated. Agston in an article in the
Edin. Med. Journal for Oct. 1880
reports that out of 36 ~~of~~ cases observed
during the later stages 20 had the pupil
dilated, in the others it was contracted
but he does not say if contraction
persisted till death or deeper narcosis came.
Lallemand, Pissin & Duruy found that
a fresh dose of alcohol given to a

which had already a dilated pupil caused the pupil to contract momentarily. Austin thinks "that the momentary contraction would be caused by the pumping action of the heart which would quickly follow the administration of the additional dose. The subsequent dilatation represented the expulsion of the blood from the vessels of the iris which would occur as soon as the more complete death of the pupil nerves had removed all nervous influence and the commencing death of the tissues themselves allowed a process similar to the formation of a pyo mother to begin in them". (5) Dimesis is brought on in almost all persons by large doses of alcohol and is due to the paralysis of the sympathetic and also to the large quantities of fluid which are ingested. In some cases the urine has been found albuminous. Lancet, in the Oct. de Review Med.

vol. II p. 621 has reported the case of a man who came under his care with this disease. He was a robust man 25 years of age in 3 days had drunk 20 litres of wine. Two or three days later he felt a violent pain at the level of the right hypochondrium his complexion became discoloured and his legs oedematous. On the seventh after the access he entered the hospital and his urine was found to be albuminous. Ten days later he suffered from pain in the renal region, bloody urine with abundant flocculent precipitate containing blood puscles, fibrinous casts, epithelial cells. At the end of a few days he recovered. Obviously there exists a modification of the disease of the kidney and principally of the epithelium of the tubule. Like Echinococcus & Pneumonia shows itself some days after.

Anatomical appearance found in the body after death. There is considerable

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congestion of the pulmonary parenchyma, of the meninges of the brain and of the cerebral substance. The cavity of the heart and the large veins are distended with dark fluid blood mingled with clots.

M. Lardier made 7 autopsies on individuals who had succumbed to drunkenness and found in two cases a pulmonary apoplexy; in five a meningeal hemorrhage. Twice there was besides an effusion of blood into the cavity of the arachnoid, an effusion into the lateral ventricle with destruction of the interventricular partition. In these cases the brain exhaled a very strong alcoholic odour, the blood enclosed in the heart and vessels was black and fluid. Once only the heart contained a few clots of slight consistency. (*Annals d Hyg. et de Med. leg.* Vol. LXIX p. 290. 1848). From these facts he concludes that in death from drunkenness pulmonary apoplexy and menin-

geal apoplexy are lesions which if not constant are at least very frequent and almost characteristic. Lalle and Perrin did not find these lesions in the dogs they had killed by alcohol. They found during life and after death in their experiments the blood studded with a crowd of brilliant points like particles of cholesterine, which examined microscopically were found to be globules of fat. Magnus Huss has found the same in the blood of individuals who have died from drink. (Chronische Alkoholkrankheit, aus dem Schwedischen. Setzt, von Gerhard van dem Busch p. 27.

Mode of action of alcohol. Alcohol may be introduced into the body by various channels, by the stomach, by inhalation, by injection into the rectum, into the veins, subcutaneously and into

erous curties. The usual mode of administration is by the stomach where it is taken up by the blood vessels and lacteals, and carried through the body by the circulation. It is the generally accepted opinion that it is through the medium of the blood that it acts upon the brain and nervous system. Some eminent men have been of a different opinion. Arfken attributed the effects of drunkenness to an action upon the nervous extremities which would react in their turn upon the center without the intervention of absorption. Brodie in a memoir communicated to the Royal Society of London in 1811 maintained the same opinion. Carpenter (on the Use and Abuse of Alcoholic Liquors 1850) thought that alcohol had an accessory influence in this way. An important paper on the subject was read by Dr. Marcet at the Meeting of the Brit. Association in Aberdeen

in 1859 and printed in the New Times &
for March 3^d. 17th & 31st 1860. The object
of the ~~experiment~~ communication was
to establish the mode of action of alcohol
on the nervous centres or rather the channel
through which alcohol acts on the
centres. The author's experiments are
divided into three series. In the first he
studied the action of alcohol on the
animal, choosing the frog on the one
and the dog on the other. In the second
nerves supplying the parts placed in
contact with the alcohol were divided,
circulation remaining undisturbed.
only were used in this series of experiments.
In the third series the circulation in
parts in contact with the alcohol
was arrested, so that none of the poison
could possibly be carried to the nervous
centres; care being at the same time taken
to leave the nervous connections between

the parts poisoned and the nerve centres entire. Frogs and dogs were employed in these experiments. The chief conclusions to be drawn from the experiments related in this paper are as follows:

1. That alcohol acts, principally, though not exclusively on the nerve centres by means of absorption, and consequently through the circulation.
2. That alcohol exerts a slight but decided action on the nerve centres, through the nerves independently of the circulation.
3. That the action transmitted through the nerves may be of two kinds - (a) It may give rise to a shock, or temporary complete suspension of sensibility and motility (with the exception perhaps of that of the eyelids), although respiration continues.
- (b) It may produce no other visible effect than hastening death.

These conclusions cannot be accepted

without much reserve. If the alcohol was more concentrated it would no doubt produce a considerable amount of shock from its action on the nerves of the stomach, but when the alcohol is diluted & taken in a moderate quantity, its ~~only~~ action can only be through the circulation.

Influence on Circulation. Alcohol produces very different effects upon the heart and blood vessels according to the quantity that is given and the susceptibility of the individual to its influence. By a small dose the heart is strengthened but made quicker, unless it has previously been unnaturally slow; if too rapid of debility its frequency is reduced. (Anstie) The tension of the blood vessels is increased. The temperature of the surface is comfortable and there is no flushing, but a slight glow. This is what Anstie calls its stimulating action ^{on} the circulation.

Dr. E. Smith (Brit. Med. Journal Nov. 23 + 16th
Vol) says it increases the force of the heart's
action as proved by the fullness and
sharpness of the pulse, by the pulsation at
the temples and in the small arteries of the
hands as they lie upon the table and the heave
to which the foot is jerked when after taking
a glass of spirit & water we sit with the
legs crossed. It determines the blood to the
extremities and to the surface, the latter
fact being proved by the increased red-
ness of the hands and face with which we
are all familiar.

Lallemand Perin & Duruy found that
large doses of alcohol accelerate the cir-
culation, but later on in the comatose stage
it is retarded.

Anstie (Stimulants & Narcotics) found that
a narcotic dose always increases the frequency
of the pulsation to a decidedly abnormal
extent (unless it be so large as to cause a

profound degree of cardiac paralysis
It varies extremely according as the current
is slowly or rapidly changed with a large
of alcohol. In a large number of cases in the
human subject the excessive rapidity
before death or the commencement of
covery to a depression both in force & frequency
which places it below the line of health.

Parkes & Molloney (On the Effects of Alcohol
on the human body - Proceedings of Royal
Society Vol XVIII p. 362) made a series
of careful researches on the subject. For 26
days the man experimented on remained
on a diet similar as to food and time
of meals in every respect: on the first
days he took only water (coffee tea
simple water): for the next 6 days he
received spirit - on the first day one
ounce of alcohol - on the second day two
ounces - on the third day four ounces
on the fifth and sixth days eight ounces

He then returned to water for ~~6~~ 6 days; then for three days he took half a bottle of fine brandy (12 ounces or 341 C.C.) containing 48 per cent of alcohol. Then for 3 days more he returned to water.

The pulse (taken 'usually every two hours) was decidedly more frequent when alcohol and brandy were used. The mean of all the observations in the recumbent position was 73.57 in water period - during alcoholic days the mean number was 88.5 - after alcohol in second water period 78.6 - during brandy days 91.4 - period after brandy 81.1. The pulse was not only increased in rapidity, it was fuller - it appeared to have more volume. Sphygmographic tracings were taken of the pulse in the various periods - "The tracings in the alcoholic period show of course a greatly increased rapidity of beat. The first event (to use Dr Burdon-Randerson's term) or systolic wave is better marked - the ascent

of the lever is more vertical and is for
an amount. The summit is sometimes
but in most cases is rounded. The second
or arterial pressure is not apparently
much altered and in most cases is pro-
bably not changed. The third event or diastolic
collapse is more rapid than before
alcohol; there is very little evidence
the fourth event or diastolic expansion.
The interpretation is that there is more
frequency of the ventricular contraction,
increased rapidity of each contraction,
the ventricles are therefore doing more
in a given time, the period of rest for the
heart is much shortened, the blood
moves more freely than usual through
the capillaries, so that the increased
quantity of blood which it is to be presumed
is thrown into the arteries is easily
removed. (p. 370). "Putting together the
deduced from the pulse as felt by the finger, from

the state of the cutaneous vessels and from the
sphygmographic tracings, it seems fair to
conclude that the chief effects of alcohol
on the circulation in health are on the ven-
tricles (the rapidity with which contractions
are accomplished being greatly increased)
and on the capillaries (which are dilated &
allow blood to pass more freely through them)
The valuable observations of Dr Austin
have shown that in many febrile cases
when alcohol is acting usefully the arterial
tension is increased, while in other cases
where there is narcotism the tension is lowered.
In the healthy man the effect of either
small or large doses on the tension is not
perhaps well marked." (p. 380).

Dr Parker's subsequent researches fully
confirm these facts. Dr B. W. Richardson
(Cotton Lectures p. 50 says that the effect
of alcohol is to paralyze the vaso motor
nerves and allow the dilatation of the cap-

illaries, which removes the resistance of heart "It begins to run quicker like a wheel from which the pallets have been removed and the heart stroke losing nothing in force is greatly increased in frequency with the weakened pericard stroke".

Influence on Temperature. It is a general received opinion among the common that alcohol warms the body and hence when cold they take a "little drop" to warm them. If it is truly a "little drop" or what Anstie would call a stimulant dose no change will occur except a slight feeling of glow, but if the "little drop" is a narcotic dose there will first of all be a rise of temperature due to paralysis of Sympathetic, by which the minute capillaries are dilated and gorged with blood but the extra heat thus produced speedily evaporates and in a short time the body is as cold, if not colder than before.

For a long time alcohol being a species of hydrocarbon was thought to be a heat producing body and was included in what Liebig called the "Respiratory Foods". The theory was that alcohol by union with the inspired oxygen became speedily broken up into H_2O and CO_2 , and in this way contributed to keep up the animal heat. This view has now been abandoned in consequence of a number of researches which have been made from time to time. Sallerhans & Perin & Durig found that alcohol in poisonous dose first raised the temperature in dogs and afterwards lowered it. D. Ringer & Richards read before the Roy. Med. & Chirurgical Society of London June 26th 1866 a paper giving an account of their experiments on temperature in non febrile and febrile persons. An epitome of this paper is given in the Lancet vol. II.

1866. p. 208. In persons down to the
iron febrile persons the temperature was
decreased in two by 3° Fahr. and in the
who was a habitual tippler it was
influenced. Alcohol injected into the
thorax of two rabbits caused a depression
of 15° Fahr. Alcohol was next given
in ordinary doses to non febrile persons.
Eleven observations were made. In
three there was slight depression. In three
adults there was no difference. The
quantity was an ounce of brandy.
The authors conclude that the amount of
depression is too slight to contraindicate
its use in febrile doses. They found
after numerous observations that al-
cohol had little influence on the tem-
perature of febrile persons.

Dr B. W. Richardson (Camden Lectures)
gives the result of his elaborate ex-
periments. In the first stage, that of excitement

external temperature of the body is raised
In birds it may rise to a full degree - in mammals it rarely exceeds half a degree. In men it may rise to half a degree & in the case of human embryos whose cutaneous vessels are already engorged it may rise $1\frac{1}{2}^{\circ}$. This heat is not due to the combustion of alcohol, it is in fact a process of cooling.

In the 2nd stage (that of excitement with some muscular mobility and want of auto-matic control) the temperature comes down to its natural standard, and then declines below that: - In men it declines $\frac{3}{4}$ ths of a degree - in birds $1\frac{1}{2}^{\circ}$ to 2° . - in dogs & guinea pigs one degree.

In the third stage (ascending movement emotional excitement with loss of voluntary muscular power and ending in helpless unconsciousness) the fall of temperature rapidly increases and may become

dangerous - in birds $5\frac{1}{2}^{\circ}$ - in other animals
 3° - in man $2\frac{1}{2}^{\circ}$ to 3° .

Details of the experi-
ments have already
been given when
considering the palea

Parker & Mollowney (Vol XVIII Proceedings
Royal Society p. 365) found that if the
means of the days of the different periods
be put together and the means for each
period be taken the results are -

	Mean Temp.	axilla
Before alcohol	98.207	
During alcohol	98.49.	
After alcohol	98.266	
During brandy	98.51	
After brandy	98.27	

The change in temperature was more
important.

In the Rectum the results were -

Before alcohol	98.86
During alcohol	99.31
During water	98.86
During brandy	99.33
After brandy	99.21

Instead of diminution of temperature

there is slight increase in the second &
 fourth periods as compared with the first
 and third: - though the difference is not
 great - $\frac{1}{2}$ a degree. They say "the general
 result surprised us considering the nume-
 rous experiments in which it has been found that
 the temperature has been lowered; but we
 never aimed at producing decided reac-
 tion or marked symptoms of poisoning
 and we had to deal with a healthy resisting
 organism which always received the same
 quantity of food: the effect might have been
 different in an ill fed or unhealthy body.
 They do not think that the increase of tem-
 perature was due to heat produced by the
 combustion of alcohol. It was more proba-
 bly due to a quickened circulation and
 in addition to slight febrile attacks on the
 12th & 13th days, but this would not account
 for similar slight increase in the brandy
 period. - Their subsequent researches on

The same subject in vol XIX p. 79 &
vol XX p. 402 of the Proceedings of
Royal Society, confirms the conclusions
that are here stated.

Elimination of Carbonic acid. Now
do they correct that alcohol in the blood
was broken up into Carbonic acid &
water we might naturally expect the
elimination would be increased to an
extent proportionate to the amount
alcohol injected or if that were ^{not} the
case as Mr. Sullenman & Perrin
have pointed out, the amount of Carbonic
acid in the blood would accumulate to
an extent as to ^{be} incompatible with life.
But in Sullenman's experiments the
blood retains its normal color
and all its apparent qualities even
last limits of mortal alcoholic in-
jection, contrary to the opinion of
Shardat who asserts that in these con-

the blood corpuscles in the arteries lose their colour and animals die as if they had been plunged into an atmosphere deprived of oxygen. But instead of being ~~decreased~~ increased it has been ascertained by numerous observers that it is considerably diminished. Prout, Lehmann and Verrodt have proved that a few moments after the injection of alcohol, the quantity of Carbonic acid diminishes in the expired air and the diminution persists for some time after which the normal proportions of Carbonic acid are reestablished. (Lehmann: *Précis de Chimie physiologique animale* p. 358) (Verrodt - *Physiol. des Athlètes*. Karlsruhe 1845). In a paper read before the Brit Association at Oxford and published in the *Philosophical Transactions* for 1859 Dr E. Smith states that Brandy and Gin lessen the quantity of carbon evolved. - alcohol, rum &c

increase it. Whistly varies in its action. Maurice Perrin in *Bull. des Sciences* Vol II p. 585 details a series of experiments undertaken to test this question. Moderate doses of alcohol. He found a decided reduction in the quantity of lactic acid excreted. This reduction was at its maximum three hours after ingestion of the alcoholic liquor; two hours later it appeared to be exhausted. This we found that there was no decrease in quantity of urea and concludes from that alcohol interferes with the oxidation of the terminal principles, but has no effect upon the oxidation of the products of the economy.

Dr. B. W. Richardson (Cantor Lecturer) found that Carbonic acid was diminished one-third in animals.

Parker in his latest researches though not directly denying the demonstration

of Carbonic acid thinks that the subject requires re-investigation; since alcohol has only a negative influence on the excretion of urea, he thinks it can hardly depress the metamorphosis of tissues or substances furnishing Carbon without affecting either the changes of the Introgenous structures or the bodily heat. He thinks fresh experiments should be made on the subject.

Why is Carbonic acid diminished?

Lallemand & Perin think that it may be caused by alcohol retarding the decomposition of the immediate principles of the organism, or the exhalation of alcoholic vapours by the pulmonary surface replacing in part that of Carbonic acid or in the dissolving power of alcohol superior to that of water in regard to Oxygen and Carbonic acid. They however argue upon the fallacy which has been set up by themselves but long ago disproved, that alcohol is

is not destroyed in the body, but is eliminated as it went in. Am carefully thinking over the subject. I am of opinion that the diminution of Carbonic acid (assuming that it is diminished) is due to the oxidation of the alcohol which seizes the oxygen and by its agency is reduced to secondary products, though what they cannot yet be clearly stated: but it is well established that alcohol must be reduced in the economy - It does not only follow that if alcohol is destroying the body it should increase the temperature ordinary food does not do so.

Influence on Urine + Urinary Excreta.

Dr E. Smith in his articles in the Brit Med. Journal Nov. 20 + 16th 1861 says that it lessens excretion of water by the Kidneys. In his experiments on persons he found the urine was reduced 20 or

per day on an average of three days by 20 ounces of alcohol daily in form prisoners working the treadmill and who for months had taken no alcohol. Some alcohols as gum increase the action of the kidneys at least for a time, but that action is not due to the alcohol. When alcohol appears to do so it is by lessening the power of the sphincter. It lessens the secretion of urea by the kidneys. He says this has been universally admitted and will follow from the diminished secretion of urine.

These views of Smith are directly contradicted by the elaborate researches of Parkes and Mollowney recorded in the Proceedings of the Royal Society Vol. XVIII p. 380.

They found that the amount of urine in the alcohol period increased 142 C.C. while the water taken was less by 124 C.C. and the same result in a less degree occurred in the brandy period. There is no doubt that the alco-

increased the urinary water.

The area of 24 hours was determined by a large Mercuric Nitrate solution, the color being got rid of and in addition the total nitrogen was determined by soda-lime after the method of Voit and leading the ammonia into a standard solution of sulphuric acid. The conclusion they come to is that "the disturbing influence from these febrile conditions being allowed for it may be concluded that alcohol in the above quantities produces no effect of importance in altering the elimination of Nitrogen in the healthy body when the ingress of Nitrogen is constant. If any change does occur which is not even it is on the side of increase; and this might easily be accounted for by the increased rate of the heart's action, and the augmented flow of urine, which would carry a little more area with it." There was no increase in the Phosphoric and two Chlorine, but free and

was slightly raised.

Is Alcohol destroyed in the body or does it pass out unchanged?

Previous to the year 1800 it was the generally received opinion that alcohol was destroyed in the economy and that none of it was excreted, though Magendie had announced that half an hour after its ingestion, blood exhaled a strong odour of alcohol and that it could be withdrawn from it by distillation. (*Précis élémentaire de physiologie* vol. II p. 187). M.M. Bonchardet and Landrus having submitted to distillation the blood of dogs, fowls and ducks to which they had given alcohol as well as blood drawn from the vein of a man in drunkenness, obtained a product which to them appeared to exhale a slight alcoholic odour (*De la digestion des boissons alcooliques et de leur rôle dans la nutrition* - *Annales de chimie et physiologie*).

ologie p. 448). Maynard and Tiedem
had announced that alcohol was ex-
posed from the economy by the lungs. Klenow
the only experimenter who had discovered
passage of alcohol in the urine and in
bile. Liebig who has divided all foods
into Plastic foods + Respiratory foods
has placed among the last Beer Wine
and Brandy. "Alcohol, says Liebig
occupies a distinguished rank as an
agent of respiration. The physician
alcohol dispenses with the use of starchy
+ oily foods, but alcohol is
compatible with fat - Persons accustomed
to the use of wine, lose the desire and
for it when they take cod liver oil."
Vellus Letter sur la chimie - édition
faite public par Guhardt 1852.
"Respiratory foods are distinguished by
the rapidity and duration of their effect.
It is several hours before the starch of

bread dissolved in the intestines arrives in the blood and finds there its use. Milk sugar & grape sugar have no need of that preliminary dissolution by the digestive organs: they pass more rapidly into the blood. The effect of fat is slower but it persists longer. Of all respirating foods, alcohol is that which acts most promptly (Ibid p. 242).

Bouchardet and Landois have sought to determine the transformations which alcohol undergoes in the blood. After making two ducks swallow a soup made with 60 grammes of alcohol, 140 grammes of water & bread, they killed them by opening the Carotid artery. "The blood diluted with three its weight of water was filtered after coagulation - then was added to it a drachm of Sulphuric acid, it was distilled on the water bath & then passed over a liquid having a very slight acid reaction

and the odour of Acetic acid. *Annales
chimie et de physiologie* 1847 vol XX
p. 452.) The memoir of Bouchardat
London ends by the following conclusion
"Alcohol under the influence of the oxygen
introduced into the economy by respiration
may be immediately converted
into water and carbonic acid: but in
several of our observations we have ob-
tained an intermediate product, ^{Acetic acid} Al-
cohol and its products disappear
rapidly from the economy."

To demonstrate the decomposition of
alcohol in the blood M. Duchek has made
a series of researches, the idea of which
was inspired by Liebig's theory upon the
of alcohol as respiratory aliment.
(*Prag. Vierteljahr. Schrift für die
tische Heilkunde* 1853. Duchek, *Ueber
des Verhalten des alkohols im Thier-
Organismus*). He found by introducing

put into the stomach of a dog he obtained the
 reaction of aldehyde in the blood. In another
 experiment he injected 3 drams of aldehyde
 into the jugular vein and afterwards found
 acetic acid in the blood. In another experiment
 he introduced acetic acid & found that it
 changed into Oxalic acid. These are the con-
 clusions which terminate the memoir of
 Duchek "Alcohol introduced into the diges-
 tive tract traverses the wall of the vessels where
 it is immediately converted into alde-
 hyde. It is in the state of aldehyde that
 it assumes in all the tissues with the blood.
 Aldehyde introduced into the stomach
 produces the same drunkenness as al-
 coh. After the administration of aldehyde
 we find in the blood acetates and oxalates
 which appear to be the result of the oxidation
 of aldehyde. We find at the same time
 oxygen in the blood."

M. Duchek uses his theory to explain the

denomination which appears to exist in the proportion of Carbonic acid CO_2 produced during the first periods of the ingestion of spirituous liquor - Alcohol takes away two equivalents of Oxygen to become aldehyde. Aldehyde in its turn reacts upon Oxygen and it is only after it has been oxidized that the nascent Oxygen can combine with carbon and the exhalation of Carbonic acid return to its natural proportion.

Such was the general opinion until 1850 viz that alcohol was a respirating food and was converted either immediately or by a series of transformations into Carbonic acid and water.

In that year there was published a Memoir by three eminent French Chemists, Dumas, Dulong and Berthollet and which for a time revolutionized opinion on the subject. (*De rôle de l'alcool*)

des anesthésiques dans l'anesthésie.)
The object of their elaborate experiments made principally on dogs was to verify the presence of alcohol in the blood and tissues and to ascertain if it suffered any transformations in the blood and tissues and whether it was eliminated from the body by any of the ordinary channels of excretion. The alcohol was generally given in large doses sufficient to plunge the animal into profound coma. They used two methods to verify the presence of alcohol in the organs. When it existed in sufficient quantity they gathered it in kind by distillation and verified directly its physical and chemical characters. When it was in feeble proportion they had recourse to chemical reaction by an analytical procedure which permits of verifying the proportional quantities of alcohol which the

which the solids and liquids contain.
A current of air traversing equal weight
of organic substance carried off the
alcohol and carried it off in vapour
into a standard solution of ~~Cerulean~~
Bichromate of Potash in Sulphuric
acid - the proportion of alcohol being
indicated by the volume of liquor modifying
its primitive colour.

In the first group of experiments alcohol
was withdrawn in notable quantities
by distillation from the blood, nervous
centres, products of pulmonary ex-
piration and urine. They found that a
small portion of the alcohol injected
was transformed in the stomach into
Acetic acid. They found the amount
of alcohol in the pulmonary ex-
piration small, but maintain that it does not
represent all the alcohol expired, ac-
cording to the difficulty of collecting it.

In the second group the presence of alcohol was demonstrated by the analytic procedure already alluded to.

In the third group they demonstrate that the blood of alcoholized animals contains none of the intermediate products of the oxidation of alcohol viz aldehyde - acetic acid or lactic acid. Even admitting they say that acetic acid is found in the blood it does not necessarily follow that it should come from alcohol. It has been found in the blood of other persons by some observers. Scherer has found it in the muscle and spleen. Schultze says that it exists in the saliva as acetate of soda.

In the fourth group they demonstrate that aldehyde introduced into the stomach is found in kind in the blood, the viscera and the urine, that it is partially transformed into acetic acid in the blood, but not into lactic acid.

In the fifth group they show that after the introduction of alcohol into the organism it escapes in the pulmonary exhalation by the skin and especially by the kidney. "A man who had taken no spirituous liquors since the night before, drank at his breakfast a litre of red wine having an alcoholic percentage of 10 per cent. The lungs continued to eliminate alcohol for eight hours and the kidneys fourteen hours. As we get further from the moment of injection the proportion of alcohol diminishes in the products of excretion which withdraw this body from the economy". (p. 120).

We administered to a lettuce by the stomach 30 grammes of alcohol at a strength of 21 degrees diluted with an equal weight of water. Six hours afterwards it was still being eliminated by the skin - nine hours after injection

it was killed and alcohol was found in its blood and brain." (p. 122).

"We administered to another young dog of small size 40 grammes of alcohol at a strength of 21 degrees diluted with the same weight of water. Sixteen hours afterwards the animal which appeared quite recovered from mæbriation was strangled and the reactions manifested still the presence of sensible traces of alcohol in the blood and brain (p. 122)

In the sixth group of experiments they demonstrate that after the ingestion of a small quantity of alcohol they verify for several hours its presence in the blood and in the viscera and that its elimination by the lungs indicated is prolonged during the same time, diminishing in quantity as we depart from the epoch of ingestion.

They come to the following conclusions

1. Alcohol is not an aliment.
2. Alcohol is a special modifier of the nervous system. It acts in small doses as a stimulant, in large doses as a narcotic.
3. Alcohol is neither transformed nor destroyed in the organism.
4. Alcohol accumulates by a sort of elective affinity in the brain and in the liver.
5. Alcohol is eliminated from the organism in totality and in kind. The organs of elimination are lungs, skin and especially the kidneys.
6. Alcohol has a material pathological and direct influence on the development of several functional troubles and organic alterations of the brain, liver and kidneys.

The publication of these researches caused a great sensation at the time and the subject was considered by many

75.
as good as settled. Tentatively rejoined
rejoined that at last they had got an au-
thoritative physiological dictum on
their favor. But in a short time these
experiments & conclusions were called
in question in France by M. Blandot
(Nouv. Medecine Sept & Nov. 1863) and
in England by the late lamented D An-
ster of London. M. Blandot in his re-
searches throws great doubt on the cor-
rectness of the opinions in question, espe-
cially as regards the part supposed to
be taken by the kidneys in the work of
elimination. He says if Sulloway & Co.
are correct a sensible result capable
of being appreciated by the alcohometer
should appear on examination of the
urine voided during 24 hours immedi-
ately succeeding the taking of a dose of
alcohol. Such is not the case except
when the dose has been excessive. He finds

the chromic acid test very delicate and capable of revealing in the urine the presence of a proportion of alcohol so small one centigramme to the litre.

Anstie (Stimulants & Narcotics) corroborates the delicacy of the chromic acid test. He found that $\frac{1}{120}$ th of a grain of alcohol of one cubic centimetre of the test liquid. He found that when a moderate dose of alcohol was taken such as a pint of light beer or a glass of cherry only a minute quantity was eliminated by the kidneys and the same by the lungs. As he says is more plainly proved by Dr. Knapp Perrin & Buray than the fact that long after the latest period at which any of the alcohol absorbed can be recovered in the breath urine and sweat unchanged alcohol in notable quantities can be found in the blood and tissues. This unchanged alcohol may have been

time to transformation in the tissues, there being no reason to suppose, as Barendse says that the substance should be transformed immediately. Austin thinks it is worthy of remembrance that Sallomon and Perrin and Duray found that aldehyde was in part transformed into acetic acid.

The elaborate researches of Schulz in Archiv. der Naturkunde 1866. afford an independent support to Austin's proposition regarding the elimination of alcohol. Schulz takes the extreme case of highly intoxicating doses administered to animals. He kills the animals within a few hours after administration and shows that while a trivial portion of the alcohol only has escaped in the urine, a notable proportion probably not less than one-fourth of the quantity injected has ceased to be recognisable in the body as alcohol. Now as the kidneys are con-

tantly the chief channel for whatever elimination occurs (when the animal is per-
son is quiescent) thus amounts to a demon-
stration that a large disappearance of
alcohol has taken place without the
vention of elimination. The missing part
must have been decomposed. It is clear
that even in circumstances of downy
narcotic poisoning by alcohol, it is not
by elimination of the poison, but chiefly
by destructive decomposition that the
organism is enabled to recover from
its depressing effects.

In a paper published in the *Lancet*
of Aug. 17th 1867 p. 190 Austin gives
account of some experiments under-
taken along with Dupré on the elimina-
tion of alcohol. They first determined
that in distilling a mixture of alcohol
and water there was scarcely even
more than $\frac{1}{1200}$ the part of alcohol

wasted - thus disproving the assertion of
Lullmann Perini and during that the
great volatility of alcohol prevented a
just estimate when it was present in
small quantities. They then made a number
of experiments on themselves with full
known intoxicant doses of ~~alcohol~~ of var-
ious French and German wines, doses of
different kinds of wine containing one
ounce of absolute alcohol in each
experiment were taken, and some
urine was passed hourly subsequent
to the dose until a point was reached,
at which the distillate of the urine last
secreted gave no reaction with the test.
At a very early period Dupre convinced
himself that too much quantities of alco-
hol could be recovered as could be estimated
by the alcoholometer or by the formation
of an inflammable liquid. To estimate
the alcohol accurately they had recourse to

Standard Column tests made with alcohol of a known strength. They made a large number of experiments of which the following is a sample: After a dose of Rhine wine containing one ounce of absolute alcohol elimination ceased within 4 hours and the total amount excreted was $\frac{2}{3}$ ths of a gram. In another experiment with claret elimination ceased after one hour and the amount was too small to be estimated. They found that if not more than one ounce or an ounce and a half of absolute alcohol was taken, the total amount of renal elimination even by any possible chance exceeded half a gram.

As for excretion by the skin Dr Austin found by experiment on himself that it could not be more than one-third of a gram and was probably considerably less. By the lungs they are of opinion

that only a minute fraction of alcohol is eliminated after a moderate dose of alcohol and that it is of very brief duration, usually not lasting more than one hour and not longer than three or four hours.

The lecture was continued in the *Lancet* Sept. 28. 1867 p. 385. He found that when intoxicating or narcotic doses of alcohol were taken the elimination by the kidneys, lungs and skin was considerable. Dr. Dupré tested kidney elimination in a group of healthy persons who were all rather decidedly narcotized by taking claret in quantities ranging from 24 to 36 ounces. Ten bottles containing 10000 grains of absolute alcohol were drunk by six persons - 100 grains or one per cent of absolute alcohol was recovered from the urine.

Parker & Molliniez (*Proc. Roy. Soc.* vol. xviii p. 309) think that the elimination of alcohol does not take place so rapidly as

is supposed. Looking to the evidence of the pulse, sphygmographic tracings and of the urine on the 3rd day they concluded that 29 ounces of absolute alcohol having been taken in six days, the body had still traces of it on the sixth day after the alcohol was left of. They think that though not excessive the exit by the urine is continued longer than is supposed and when the constant passage from the skin, lungs and bowels is remembered we can easily suppose that the totality of elimination may be considerable. From their experiments they were unable to tell whether all the alcohol passes off from the body in this way or whether some is destroyed. We thus see that their opinion leans towards Lallemand and Perrin and Duray and they incline to think that all is eliminated, but we must say that they advance only slender evidence.

to support their conjecture. These experiments show very well that urinary elimination never becomes more than a trace till narcotic doses are reached. It was also with narcotic doses that ~~the~~ Parker & Mollowney procured evidence of what they believed to be a continuance of elimination for several days.

These views of Parker and Mollowney led Dr Dupré again to investigate the subject, the result of his observations being given in Vol. XX Proc. Roy. Society p. 268. Assuming for the sake of argument that 10 days was occupied in eliminating the alcohol, it would follow that if a certain quantity were taken every day, the amount eliminated would increase from day to day until from the 10th day onward the quantity eliminated daily would equal the daily consumption, in other words the quantity eliminated, if this theory be correct,

is supposed. Looking to the evidence of the pulse, sphygmographic tracings and of the urine on the 30th day they conclude that 29 ounces of absolute alcohol having been taken in six days, the body had still traces of it on the 30th day after the alcohol was left off. They think that though not excessive the exit by the urine is continued longer than is supposed and when the constant passage from the skin, lungs and bowels is remembered we can easily suppose that the totality of elimination may be considerable. From their experiments they were unable to tell whether all the alcohol passes off from the body in this way or whether some is destroyed. We thus see that their opinion leans towards Lallemand and Perrin and Dury and they incline to think that all is eliminated, but we must say that they advance only slender evidence

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would be measured in ounces and could be as-
surable by the most ordinary method of
analysis. The argument loses none of its
force if it be contended that elimination
lasts longer than 10 days, for however long
it may be continued a time must come
when elimination and consumption
~~would~~ would be equal. The alcohol if not
eliminated must accumulate in the body
and would speedily rise to a proportion
totally incompatible with life itself. The
experiments detailed in the paper are
guided by the foregoing considerations.

The results of the experiments may be sum-
med up as follows:- The amount of the
alcohol eliminated per day does not in-
crease with the continuance of the alcohol
therefore all the alcohol consumed
daily must of necessity be disposed of
and as it certainly is not eliminated for
in that time it must be destroyed in the expe-

The elimination of alcohol following the ingestion of a dose ~~for~~ or doses of alcohol ceases in from 9-24 hours after the last dose has been taken. The amount of alcohol eliminated in both breath and urine is a minute fraction only of the amount of alcohol taken.

In the course of these experiments the author found that after six weeks of total abstinence and even in the case of a teetotaller a substance is eliminated in the urine and perhaps also in the breath, which though apparently not alcohol gives all the reactions ordinarily used for the detection of alcohol. The quantity present in urine is so small that the precise nature of the substance has not as yet been determined. Finally the author points out an apparent connection between this substance and alcohol. It was found that after the elimination due to the ingestion of alcohol

had ceased, the amount of the substance eliminated in a given time at first remained below the quantity normally excreted and only gradually rose again to the normal standard. A careful study of this condition may perhaps serve to throw some light upon the physiological action of alcohol.

In the autumn of 1873 Dr Anstie in order to finally settle the question of the elimination of alcohol with the assistance of Dr Shippen performed certain experiments. These experiments are detailed in a paper by Dr Anstie in the Practitioner for July 1874, being one of the last if not the last which that gifted and much lamented physician gave forth to the profession. The experiments were made on two dogs. The following are the conclusions he comes to. "The experiments on the dog A showed that 67.73 grains of alcohol can be disposed

of by a little more within eight hours with only the elimination of one-fifth of a grain of unchanged alcohol by all channels together. The experiments on the dog Bismarck that a terrier of less than 10 lbs. weight could take with comparative impunity nearly 2000 grains of absolute alcohol in ten days; that on the last day of the regimen he only eliminated by all channels 1.13 grains of alcohol; and that on his being killed (two hours after swallowing 95.1 grains of absolute alcohol) only 23.66 grains were recovered from his whole body and all its contents, elaborately treated so as to provide against material loss during the examination. These experiments certainly furnish us with final and conclusive demonstration, as regards dogs, of the correctness of Dr Dupré's arguments against the possibility of material accumulation of alcohol in the body."

After these elaborate and convincing experiments no one can doubt for a moment that alcohol is destroyed in the body and that only a minute fraction is eliminated. What alcohol is decomposed into within the body, nobody yet knows and will be rather a difficult question to solve, but that it is so decomposed I have no the shadow of a doubt.

Alcohol in Acute Diseases.

Whatever opinion may be held by physiologists as to the action of alcohol in the healthy body there is a pretty general consensus of opinion as to its virtues as a therapeutic agent, though some physicians place more faith in it than others. At the beginning of this century and during its first half the depleting and antiphlogistic school were in the ascendant, ^{and} stimulants were rather ignored, but by and by in the reaction which took place, against the principles

of the antiphlogistic school stimulants which
had been used by isolated practitioners such
as Alison, Graves and Stokes came more
and more into vogue and this reaction
reached its height in the Practice of Dr
Lodd. Since his death there has been a
tendency to question the good of what
was called indiscriminate stimulation,
and a desire to use them in greater moder-
ation, and an endeavour to define clearly
the indications for giving them.

In the 15th volume of the Dublin Med Journal
and there is a paper by Dr Stokes on
the use of wine in fever in which he
directs attention to the phenomena of the
heart's action as an index for the adminis-
tration of wine in fever. He thinks the
pulse a fallacious guide and that our
attention should always be directed to the
impulse and sounds of the heart for guidance
either for the administration or withholding

of stimulants. After detailing certain phenomena which in his opinion indicate a softened state of the heart he says: "Finally I would draw the particular attention of my readers to the fact that in the great majority of these cases the use of wine is followed by the happiest effects. I may safely refer to the Cases in proof of this proposition and I believe that in the diminished impulse and in the feebleness and extinction of the first sound we have a new direct and important indication for the use of wine in Typhus fever. Among the conclusions to which Dr Stokes has come to we may quote the following - "That the diminution or cessation of impulse, the proportionate diminution of both sounds or the preponderance of the second sound are direct and nearly certain indications for the use of wine in fever. These doctrines receive the confirmation of Dr Graves though he does

demurs to Stokes conclusion in attributing the phenomena of a debilitated heart to a softening of that organ (Lect. on Clinical Medicine p. 185).

Dr Armstrong as quoted by Dr Graves (Lect. on Clinical Medicine p. 186) lays down the following points as worthy of attention in forming an opinion of the propriety of persevering in the administration of wine to a patient in Typhus Fever.

1. If the tongue become more dry and baked it generally does harm; if it becomes moist it generally does good.
2. If the pulse becomes quicker it does harm, if it be rendered slower it does good.
3. If the skin become hot and parched it does harm; if it becomes more comfortably moist it does good.
4. If the breathing becomes more hurried it does harm, if it become more deep and

and show it does good.

Dr Todd, ^{late} of King's College London was the great apostle of the plan of systematic stimulation. The principles upon which Todd founded his plan of treatment may be summed up in the following propositions which he has laid down. (Clinical Lect. on Acute Diseases p. 1 of Preface).

1. That the notion so long prevalent in the schools, that acute diseases may be prevented or cured by means which depress and reduce vital and nervous power, is altogether fallacious.
2. That acute disease is not curable by the direct influence of any form of drug or any known remedial agent excepting when it is capable of acting as an antidote, or of neutralising a poison, on the presence of which in the system the disease may depend (Materia Morbi)

3. That disease is cured by natural processes to promote which no other full support vital power must be upheld.

Remedies, whether in the shape of drugs which exercise a special physiological influence on the system, or in whatever form, are useful only so far as they may excite assist or promote these natural curative processes.

4. That it should be the aim of the physician (after he has sedulously studied the clinical history of disease and made himself master of its diagnosis) to inquire minutely into the intimate nature of these curative processes - then physiology so to speak - to discover the best means of assisting them, to search for antidotes to morbid poisons and to ascertain the best and most convenient methods of upholding vital power.

He thinks the time will come when physicians will discard the terms Sthenic and Asthenic as applied to acute diseases and that all these diseases will be looked upon as Asthenic, and as promoting more or less undue waste of tissue, and that in treatment an object of primary importance will be the early adoption of means to uphold vital power and the watchful and continued use of them throughout the duration of the case. He thinks that alcohol or a hydro carbon has a marked affinity for the nervous system (cit. p. 455). - at first it augments the generation of nervous power - carried beyond a certain point it injures, deteriorates and destroys. He says it does not produce inflammation of internal organs; curdiness of the liver being an atrophy and not an inflammation. (?) (p. 456.) He thinks

A fallacy that if alcohol causes exaltation of nerve force it is followed by a corresponding amount of depression - a fallacy due to comparison of the patient's feelings when under the immediate influence of the spirit with the sensations which accompany the absence and the want of its exciting influence. It increases the animal temperature, strengthens the action of the heart and when administered under proper circumstances reduces the frequency of the pulse. Alcohol is an aliment appropriate to the direct nourishment of the nervous system and to its preservation; its special adaptation to this system gives it an immediate exciting power, superior to any other kind of food. Other forms of food are likewise stimulant although they do not act directly and quickly on the nerves.

system. It protects the nerves and other tissues by supplying fuel for the oxygen which supports the calorific process. Looking at alcohol in this point of view we must give enough to keep up animal heat and to protect the tissue without embarrassing the stomach and without allowing the fumes of alcohol to be perceived in the breath. All that is given over and above that quantity is wasted so far as the support of the vital powers is concerned (ibid 457-461). Alcohol may be used in those diseases in which a tendency to depression of the vital powers exist and he says there are no acute diseases in which the lowering tendency is not present. He insists upon the great importance of upholding your patient's powers while the natural processes of the disease are taking place. In pneumonia when

there is considerable expenditure of nervous force and of blood, we should supply to the System a kind of food which while easily assimilable is at the same time Capable of upholding nervous power and of maintaining animal heat. He considers it a direct antidote to Erysipelas. It has a remarkable power over Delirium. What are the signs that too much alcohol is being given? He considers it more dangerous to life to diminish or withdraw alcohol than to give too much. The signs principally refer to the digestive organs - flatulence, eructation, sickness, dryness of tongue and mouth, sores on teeth and lips. The persistence of fumes of alcohol in the breath may be regarded as a sign that too much is being administered. (ibid p. 484).

In a paper in the Lancet of March 13th

1864 Dr Gardner gives his experience of
fever in the Glasgow Fever Hospital.
He thinks there has been a tendency ob-
served in Medical practice to a more
liberal dietetic scale especially as
regards alcohol as a part of the re-
action against the depleting and
lowering system formerly in vogue.
Dr Todd was rather the exponent
of a general tendency in Medical prac-
tice, than the deviser of anything new
or striking in theory. As early as 1820
Dr Alison prescribed stimulents in
fever & this practice was carefully
followed out by his pupils ~~Stokes and~~
~~Graves~~, Graves and Stokes. He com-
pares the rate of mortality in the case
under his care with the rate of others.
For instance the rate of mortality of 59
cases treated by himself without phle-
botomy and without exclusion was 11.93
cent

The average rate of the London Fever Hospital was 20.89. In Kings College Hospital under Dr Liddel it was 25. Edin. Epidemic of 1847-48 was 20.6 to 24.72. He attributes this small mortality to the cautious way in which he gave stimulants. Between Aug. 3d and December 7th 1863 there were treated 135 males and 134 females affected with Typhus Fever, being a total of 269 cases treated to a termination in my wards. Of these cases 27 died being a mortality of 10 per cent. During the whole course of the treatment the 269 cases consumed 633 ounces of port wine and 666 ounces of whiskey or at the rate of $2\frac{1}{4}$ ounces of wine and $2\frac{1}{2}$ ounces of spirit on an average to each patient, as the allowance of his entire residence which on an average was $20\frac{1}{2}$ days. He subsequently points out in case it should be asked that this aver-

age does not mean that all the patients
got stimulants; for such was not the
Case: a considerable number received
no wine or whiskey at all, while others
received far more than is indicated in
the averages. "On the other hand in the
Glasgow Fever Hospital in the years 18
62 taken together there were 1837 cases
under treatment although only 1694 of
these were treated to a termination du-
ring the period assigned and only 1289
were Typhus. The average to each patient
was 34 ounces of wine and six ounces
of spirit. But as much the largest pro-
portion of this quantity was probably
given to the 1289 cases of Typhus it is
probable that the real average quantity
consumed by the Typhus cases may
have been not less than 40 ounces of
wine and seven ounces of spirit.
With the much larger consumption

of alcoholic stimulants the mortality of Typhus was no less than $17\frac{1}{2}$ per cent. while under the less amount of stimulants it was only 10 per cent." He strongly condemns the practice of giving stimulants to the young in fever. "He is strongly persuaded that to the young in Typhus and very probably in most other fevers, stimulants are not less than ~~actively~~ ^{actively} poisonous and destructive unless administered with the most extreme caution and in the most special and critical circumstances." The rate of mortality of young persons in his tables is 1 per cent. In Glasgow Fever Hospital 1861 it is 3.2. - in 1862 it is 3.6 - in 1847 it is 5 - in London Fever Hospital for 10 years it is 6.2. - in King's College (Dr Todd) it is 17. He does not object to the use of stimulants when carefully given, but to their use in excess or upon the plasma

Systematically advocated by Todd, his reason being that when so given "they do not support the strength, but rather pro-
mote the system by loading the blood with material which is unconvertible into blood or tissue and which arrests or interferes with the vital changes necessary to preserve the balance of waste and supply."

Dr Kennedy of Dublin in a paper in the *Lancet* of Jan. 7th 1865 strongly criticizes Dr Garrison's conclusions. He protests against the attempt to influence the practice of medicine by statistics, and denies the charge of indiscriminate stimulation advanced by the Glasgow Professor. "In Dublin," he says, "we do not use them as a febrile agent because we have fever to treat but because the case requires it." He maintains that Dr Garrison's suc-

cess in treating the young with only 1 per cent of death was not at all unusual as he hardly knows an instance of a death from typhus in the young. As to excluding wine entirely he thinks there is no class of cases of fever in which wine has a happier effect. "Less wine of course is needed and a multitude of cases even to the amount of 189 will be met which can be treated successfully without a drop." He thinks that Dr Gardner has not done justice to Dr Todd as the cases he had to treat were of unusual severity and that all the cases of fever detailed in Lect. on Acute Diseases were only 28 - too small a number to form conclusions upon.

The therapeutic action of alcohol as well as its physiology has been carefully studied by Dr Austin, a pupil of Dr Todd's, who has done more than anyone else to establish scientific principles

for the administration of alcohol. He clearly distinguishes between the stimulant and the narcotic action and maintains that as soon as the least sign of its narcotic influence appears it is likely doing harm. He agrees that the action of a small dose on the nervous system is in no sense analogous to or a part of the train of narcotic symptoms induced sooner or later by a larger dose. He insists that it is only the narcotic action which produces collapse, attended by irresistible craving for stimulants, a fever never experienced by the ordinary moderate drinker; the latter continues steadily to take the same small dose every day with the same effect. He observes that in many acute diseases, ~~the~~ such as fever and many inflammations and in severe hemorrhages the person here is evidently shifted. This is proved by the fact

that symptoms of narcotic poisoning are not induced by doses which in health might even prove fatal. Recovery from the disease is accompanied by intolerance of these large doses, but there are none of the symptoms of recovery from the collapse of narcotic poisoning. When they do occur they prove that alcohol has been used in excess or unnecessarily. Further it is to be noted that when alcohol has been used in large doses in disease and has not produced intoxication, the patient on recovering never experiences a morbid craving for drink. It is evident then that the latter can only be produced as a result of distinctly poisonous alcoholic action; and on the other hand that the beneficial influence of alcohol in acute disease is not owing to a narcotic effect. (London Med. Review - February & March 1862).

In a communication to the Lancet of Sept.

28th 1867 - p. 386, Dr Anstie from numerous observations has come to the conclusion that the amount of elimination of alcohol by the Kidneys gives us a very fair clue whether it is being given in too large quantities or not. He has arrived at the following formula which seems to him substantially correct though doubtless subject to revision through experience "When a two ounce sample of the mixed urines for 24 hours of a pyrexial patient after two distillations (with the precautions mentioned in the first part of this lecture), yields a fluid that indicates with the chromic acid test a proportion of alcohol equal to as much as one grain in 24 hours of renal elimination, the alcoholic remedies ought to be immediately diminished or discontinued. On the other hand if less than a half grain per diem be discharged from

the kidney, it is absolutely certain in my mind that the alcohol is at least doing no harm. Extended observation enables me to say with confidence that the amount of renal elimination is a fair test, in the circumstances of acute disease (unless there be extreme atrophy of the kidney gland structure) of the rate of elimination generally. He believes the elimination which takes place after a narcotic dose of alcohol is a mere accident arising from vasomotor paralysis which allows a large aqueous secretion carrying with it a greater than ordinary flow of alcohol. He thinks that the occurrence of vasomotor paralysis may be traced with great accuracy by the modifications in the pulse curve of the radial artery. (1.) "The pulse will become slower; this is invariable (2) The degree of decurtism will be diminished, that is to say that the aortic

notch will be shallowed or the diastolic wave will occur more quickly after the preceding systolic part of the curve or both these effects will be evident at once to the eye. In fact the signs will indicate that arterial tension has been strengthened and even if the heart force be strengthened at the same time, the former will be still more increased, so that the curve will present, on the whole, less of the febrile low tension type, than is displayed before the dose of alcohol." On the contrary when alcohol acts as a narcotic, it lowers arterial tension, increases the frequency of the pulse and increases the diastolic wave of the curve.

In a lecture on Pneumonia in *Lancet* of March 21st, 1874, p. 397 he lays down the further rule "that in acute pyrexial disease, in which high temperature is combined with a large area discharge,

that conjunction is the strongest prima facie reason for the administration of alcohol, and that a reduction of heat and urea discharge (or of urea discharge alone provided no toxic symptoms follow) is to be regarded as evidence that the stimulation has been rightly adopted."

Behn in an article on the therapeutic action of alcohol in *Dict. des Sciences Medicales* vol. II p. 606. gives instances of the employment of alcohol in fevers and acute inflammations during the last two centuries and says that for many years even before the publication of Stokes' researches he has employed generous doses of wine in the treatment of Typhoid Fever and other acute Maladies. Like Todd he has seen alcohol cause delirium to cease, the pulse and respirations to fall, and determine frequently an abundant transpiration, in spite of which the strength is

restored. He has never seen the least sign of intoxication. He found alcohol very beneficial in the Pneumonia of aged persons.
"It sustains the strength, renders emaciated and hastens convalescence."

Personal Experience. I have found alcohol very valuable in the febrile attacks which often take place in puerperal patients 2 or 3 days after confinement. It succeeds better than anything else in reducing the temperature and the pulse and calming the delirium which frequently accompanies these attacks. The following case which occurred a week or two ago in my practice will be a good illustration of its benefit. Mrs. F. Oct. 29 was attended by me in her fourth confinement. There was nothing unusual in her labour which was rather slow, but as on the last occasion she had suffered from a profuse flood

I administered to her before the child was
 born a full dose of *Liq. Secalis Cornuti*
 with the effect of preventing any profuse
 discharge though there was a tendency
 to it. She continued well during the
 first 36 hours after the labour termi-
 nated. Then she had a succession of
 severe rigors which shook her from
 head to foot. She had also a violent
 pain in the lower part of her belly which
 she could hardly bear to be touched.
 Her pulse was accelerated to 120 and
 her temperature soon rose to $102.5^{\circ}F$.
 I ordered a hot poultice to the belly and a
 pill containing three grains of Calomel
 and one grain of Opium. This purged her
 severely but did not ameliorate her symp-
 toms in any way. She had still excessive
 pain in the belly and complete anorexia
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and her face showed that she was in great distress. I then ordered her a tea spoonful of whiskey every hour along with a tea spoonful of a mixture of Sulph. Ammon. Acetatis and Morphine. On visiting her next morning I found her a little better, but still suffering a good deal. The temperature was 102° and the pulse 120. There was great tenderness over the belly, and especially over the uterus and there was also vaginal tenderness. The whiskey was then increased to two tea spoonfuls every hour and under the larger dose she speedily improved, felt easier and had a good sleep for several hours, with the result that next morning her temperature was reduced to 100 and her pulse to 110. The whiskey was continued as before and the next day she was very much better, her temperature was normal and her pulse 90. She was able to take

little food. Her dose of whisky was continued in smaller quantity, but now when she was comparatively well it began to disagree with her causing pain in the stomach and what she describes as a "queer feeling" in the head. I don't mean to say that this was a case of puerperal fever, starting with a local inflammation in the uterus and surrounding texture, but at one time it looked uncommonly like it, though of course if it had been pure puerperal fever nothing would have been likely to do her good. What struck me in this case was the remarkable calmative influence it had upon her nervous system which was rather excitable naturally, and though it may be thought that I am arguing post hoc ergo propter hoc, I am sure it had a favourable influence upon the pulse and temperature. When in health she says that spirits don't

agree with her and this was proved by
the way in which it acted after she had
been restored to her normal constitution.
She has since that made an exceedingly
rapid recovery and is now quite strong.
In several other cases of the same kind
I have found the value of frequently re-
peated small doses of alcohol and
this practice of giving alcohol to per-
sonal cases is I believe followed out by
Dr. Graily Hewitt and strongly recom-
mended by him.

Alcohol in Fever - My experience is al-
favourable as regards the treatment
of Typhoid Fever in the few cases that
have come under my care. I agree
with Dr. Gardner of Glasgow that
it is inadvisable to give stimulents
to children. In most cases they get
well just as soon without it and it
may do harm to their delicate and gro-
nervous system.

All the treatment required in these cases
 is plenty of milk to drink which generally
 agrees very well and if there is restlessness
 at night a small dose of Dover's powder.
 In grown up persons and those advanced
 in life the case is different and
 many a one without the help of stimu-
 lants would be sure to succumb. In
 the case of persons of intemperate habits
 and weak constitution they should be
 ordered at once as soon as the diagnosis
 is made. This was strongly impressed upon
 my mind by a case that I attended nearly
 two years ago. The patient was a man about
 40 years of age, who had done a deal of
 hard work as a collier and also a
 deal of hard drinking. During the first
 week he was walking about neither feeling
 very well nor very ill. At the beginning
 of the second week of the disease (as near as
 I could judge) I was called to see him.

Though he had no marked symptoms and was not very ill, I judged from his general appearance and the locality in which he resided, which had been during that summer a hotbed of disease, that he was going to have an attack of Typhoid fever. I ordered him to bed and prescribed a beef tea and milk diet and an expectorant mixture for the cough which troubled him, though there was no evidence of any inflammatory complication in his chest. During the next few days his symptoms gradually got worse, his pulse quicker and feebler and suddenly towards the end of the second week he began to have subsultus tendinum and picking of the bed clothes, low muttering delirium and all the other signs of complete collapse of nervous system. At this time I ordered stimulants in table spoonful doses every hour, but

with no effect as he rapidly became worse
and speedily succumbed. I don't mean
to say that stimulants would have saved
this man's life, but I have no doubt that
if I had ordered them as soon as I saw
him he would have had a much better
chance. His constitution had been viti-
ated by his intemperate habits and as
soon as the disease had fully developed
itself his nervous system broke down and
he died. Ever since then I have been
more careful to attend to the indications
which justify an early administration
of stimulants. Pneumonia in the same
class of persons ought to be treated to a free
allowance of alcoholic liquors. Sir R.
Christison in his lectures lays down the rule
that we should never be in a hurry to
resort to alcohol in fever. He says it is
a bad sign if we require to give wine in
the first seven days, but in these cases

that I have been speaking of, our only chance is a free and early administration of stimulants. The best guide is the state of the pulse and still better the state of the heart. The chief indications for the administration of alcohol are - high temperature; delirium; nervous prostration; great repleteness and deceleration of the pulse; and especially a tendency of the latter to become arrhythmic in such a manner as to show rapid and irregular changes in the force of the heart beats (Austin - On the Use of Wine in Health and Disease p. 43); diminution and cessation of impulse; feebleness and extinction of the first sound (Stokes - op. cit.). An excessively rapid, soft feeble and compressible pulse demands the exhibition of stimulants at once and if administered judiciously and in frequently repeated small doses they usually cause marked benefit, the pulse becoming slower and firmer.

the heart's impulse stronger and the first
 sound of the heart more clear and distinct.
 It has been ingeniously suggested by
 Dr Barnes (*Lancet* Vol. II 1867 p. 582)
 that alcohol acts as an antiseptic in
 fevers, by exerting that influence on cer-
 tain morbid matters in the blood, the oxidation
 of which is ~~maintaining~~ producing or main-
 taining the symptoms. If this theory be
 true it adds a powerful argument ~~to the~~
 in favour of alcohol in fever. It has a
 wonderfully soothing influence on most
 kinds of delirium which generally arises
 from a want of proper nutrition of the
 brain due to the morbid condition of the
 blood and the rapid wasting of the
 body in which the brain has its share.
 This forms a very important sign of its
 favourable action, if it calms delirium
 and procures sleep. Another important
 and useful action of alcohol in fevers

is its power in aiding digestion, a function which is always impaired if not abolished. It is a good plan to administer the stimulant along with a small quantity of easily assimilable food, as in this way we get not only the benefit arising from the alcohol but also that from the absorption of ordinary nourishment. The quantity should vary according to the age, condition and various circumstances of the case and no hard and fast line can be drawn, each case being considered on its own merits, and constant attention being directed to the appearance of any of the narcotic symptoms which have been clearly defined by Anstie, viz, flushing of the face, smell of alcohol in the breath or from the skin, an appreciable elimination from the kidneys (one gram in the 24 hours) and increased rapidity and deceleration of the pulse. It is far better to give small doses often than larger doses at longer

intervals as in this way we have more chance of securing its purely stimulant action and not its narcotic effects.

Another class of cases in which I have found alcohol invaluable are the inflammatory diseases of infants under 12 months, especially in the Bronchial Catarrh and Capillary Bronchitis to which they are so subject and which often prove rapidly fatal. The best method of treatment in these cases is the cautious administration of stimulants. The little patient should be kept in a warm moist atmosphere, have poultices applied to the chest and take one or two drops of whiskey or brandy every hour along with Spt. Ammon. Aromaticus and Chloric Aether. I have seen several nearly hopeless cases rally under the treatment, which is simple, easily applied, but should be carefully watched as any narcotic action of the Spirits would defeat

harm. The quantity of whiskey or brandy should be measured out and mixed up with sugar and water in definite proportions like any other medicinal mixture and the quantity not left to the discretion of the nurse, who has been known from want of definite instructions from the physician to plunge the little patient into a state of coma. Just now I have under my care a child of 18 months with Broncho-pneumonia after measles, whom the mother before my attendance commenced had been treating with liberal doses of whiskey as she thought that all children in measles got that valuable domestic remedy. When I first visited the child he was semi-comatose, with rapid pulse and respiration and seemed altogether in a critical condition. I immediately stopped the whiskey and ordered a tea spoonful of Cherry three times a day

and a mixture containing Spt. Ammon. Aromat. and Chloro Etha. Ever since then he has improved rapidly, but I have no doubt that the Mal-administration of the Whisky would soon have finished him.

I also use stimulants with benefit in the acute Gout and intestinal Catarrh when any symptoms of depression and collapse appear after the excessive vomiting and purging.

Alcohol has a remarkable power over the convulsions in children, which often come on in the period of teething. I was led to this practice by Dr. Parvost's recommendation of it and I have certainly found it of great service in this disorder. Cutting the gums is the usual mode of treatment, but I don't think it does much good as it is not the pressure of the tooth upon the gums but that of the thickly coming and

and crowded both in the jaw upon the sensitive branches of the fifth pair.

Alcohol in small doses is said to be useful in other convulsive disorders in adults but a large dose would bring them on.

In acute Neuralgia I have seen a small dose of alcohol give great and immediate relief, but the relief was only temporary and it is not right to recommend it for such cases, as it might easily lay the foundation of drinking habits.

Dietetic use of Alcohol. I am of opinion that a strong healthy person leading a regular life, with a moderate amount of work and partaking of plenty of nourishing food is better without any alcohol. It is superfluous to say the least of it. It may not do him any harm, but it does no good. It is different however with persons who are not robust in constitution and who are exposed to the tear and wear

Of a worrying and exacting occupation, persons also of sedentary habits and persons of weak digestion, ~~which~~^{who} are all very much benefited by the moderate and temperate use of alcohol. It aids digestion, strengthens and composes the nervous system and assists in keeping all the organs of the body in functional activity. The form may vary, some may take malt liquor, others wine, others distilled drinks diluted with water. Speaking from personal experience during the last two years, I have been greatly benefited by the use of malt liquor along with food. Since I had an attack of pleurisy three years ago I have been rather weakly in health with a tendency to contract pulmonary consumption. I have derived great benefit from the use of malt liquor especially porter in which I have more faith than in all the medicines in the world. I have found it

and digestion, increase strength so as to be able to follow the usual routine of ordinary practice and during its use I have also gained in weight. Dr Parker has written a very good article on some points in the dietetic treatment of disease in San-
cet Vol. I p. 758. He first investigated the influence of alcohol on appetite and digestion. He found that alcoholic beverages containing about two fluid ounces of alcohol produced marked lessening of the appetite in both the men experimented on who took the brandy on an empty stomach and in the man who took it with food something more than two ounces was required to produce that effect. He concludes that anything over two fluid ounces of alcohol may lessen appetite if the stomach be empty. He reports two exact observations, on which he can rely, of the influence of alcohol on

digestion. The first was that of a total ab-
 staining relative between 50 and 60 who
 got into feeble health with weak digestion.
 He was advised to take a half pint or a
 pint of beer to dinner and found that he
 ate more, digested better and recovered lost
 ground. The other case was that of the
 well known and thorough going temperance
 advocate Dr Carpenter, who however in his
 work on the subject has always main-
 tained that the action of alcohol on
 the human body when under par is dif-
 ferent ^{from} its action on an individual in
 full health and is beneficial in many
 cases with depressed digestive power.
 Under pressure of work he broke down and
 besides a local disorder suffered from total
 loss of appetite and enfeeblement of di-
 gestive powers, so that his whole system
 was undergoing a rapid lowering. He
 was recommended powerful tonics and

three glasses of Sherry daily and under this regimen he speedily recovered.

Parkes thinks that the quantity taken to aid digestion and increase appetite should not exceed one fluid ounce of alcohol and he thinks half an ounce is often enough. If this quantity does not improve appetite a larger quantity will not do so. He thinks the healthy digestion of children always injured by alcohol. It should be given with food as the alcohol becomes mixed with the contents of the stomach and acts in a diluted form on the mucous membrane and is absorbed slowly.

As regards the form in which alcohol is to be administered he recommends beer with a good deal of malt if a fattening effect is desired and no gouty or rheumatic tendencies exist. If biles and acids seem to be desirable for the kidneys, light French wines seem in good form. He does not lay so much stress

as Dr Anstie upon the ethereal element in wine. He thinks ethers are in too small quantity to have much effect on digestion though the aroma and bouquet make them pleasant to take. The most important points to look at are purity - alcoholic strength amount of free acidity, salts and extracts.

Dr Anstie in his work (Uses of Wines in health and disease) p. 36 strongly recommends the use of wine in delicate children. (1) In those children where a tendency to wasting is very marked. (2) Where trifling Catarrhal affections are easily caught and very slowly shaken off. He advises in these cases the use of Sherry or port in teaspoonful doses three or four times daily disguised in bitter. I have tried this plan in cases of this kind and have found it very efficacious. Dr Anstie also strongly recommends the more potent wines in the debility of old age,

more particularly "in the condition of sleep-
lessness, attended often with slow and in-
efficient digestion and a tendency to
stomach cramps."