Thesis
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by
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Alcohol

Its physiological action and Specific constitutional effect — alcoholism.

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There is no agent, dietetic, medicinal or poisonous that has occupied the attention of scientific minds to the extent that alcohol has, nor is there one on whose action - beneficial or otherwise - there has been so much controversy. Its general and more visible actions on the body in health have long been recognized, and of late years the most eminent authorities in physiology and therapeutics have studied it specially, and many works the result of their experiments & experiences have been published by physicians of all nations. To attempt to add to the observations resulting from such searching inquiry would be presumption: and it is not my intention to consider the question of alcohol as a food or as a Poison or to controvert its use as a stimulant in Medicine. In this paper I mean merely to notice the action of the alcoholic principle on

Small dose

Topical action

principles on
the healthy tissues of the body generally, and on
the various organs individually, dwelling more
minutely on its accumulative toxicological effects,
and enumerating the diseases which it either directly
induces or gradually predisposes to.
The conclusions are taken from cases not only in hospital
and dispensary patients where pre-existing or pre-
existing constitutional disease and debilitated condition
of body resulting from various causes, the phenomena are
greatly modified, but also from cases of patients in
the higher walks of life.
In (talking of) the action of alcohol, it is necessary
to state that alcohol in a very dilute state, or in
the form of the various spirituous liquors is meant.
A very small quantity of absolute alcohol or rectified spirits acts as a corrosive irritant on the parts
it is directly brought into contact with, and taken in-
ternally or injected directly into the venous system, it
either kills instantaneously by paralysing the nerve
centres or produces coma and convulsions before death.
First let us look at the action of a small
quantity of alcohol as taken in any of its usual forms.
Locally it is irritant and astringent and remotely

Remote action.

Action of larger doses.

and remotely
it is stimulant, tonic sedative, diuretic and antihiptic
[Christison class ref: 172]. The topical action is decidedly
irritant as seen by the reddening of the mucous membrane
with which it is brought into direct contact. The astringent
action may be demonstrated by applying it to the skin which
it first reddens and then corrugates. The naked-eye appearance
of the lining membrane of the stomach of animals treated with
small doses shows alternate red and white spots. Remotely
the first effect is also stimulation, which may vary from a
few minutes to an hour or more according to the strength and
quantity of the dose. During this period there is often agreeable
physical and intellectual excitement shown by the performance
of most fatiguing exertions with apparently little effort, and
by racy and witty remarks. The circulation is stimulated
the heart's action being rendered stronger and more frequent,
and the nervous system is also stimulated: and this is more
easily produced when the brain has been excited beforehand.
This is succeeded in some cases by an after period of
depression but the general rule is that there is no subsequent
depression or harm resulting from the gentle stimulation of alcoholics.

The general effect of large doses is a more decided excitement
of the brain and circulation, which is more transient: and is
immediately followed by a more obvious depression of the

depression of the brain first and then of the circulation and consequently of the digestion and of every important function of the body. This is manifested by confusion of thought, imperfect or double vision, indistinct speech & tottering gait; followed by speechlessness, insensibility, suffused countenance, injected eye with dilated pupil and slow stertorous breathing, most of the symptoms being similar to those of narcotic poisoning.

These general phenomena however, which may be observed in any case of ordinary drunkenness do not interest us so much as the functional derangement of organs and organic changes produced in the tissues by the long continued use of alcohol, or more properly speaking cases of chronic alcohol poisoning. Before this condition is reached, or before there is any organic disease the main symptoms found in a patient who for a considerable period has become accustomed to keep up the stimulating effect of alcohol, are as follow loss of appetite, loaded white tongue, persistent dyspepsia irregular action of bowels, & flatulency, also inability to undergo severe physical exertion or mental ~~fatik~~, and nervous excitability.

All symptoms of chronic alcohol poisoning are brought about by the actual presence in the blood throughout the entire body, of the alcoholic principle which thus?

Case of acute poisoning.

+ Subject was a girl aet. 19 who has swallowed more than a pint of raw whiskey right Nov. Autopsy made in Edin. police office May 1872.

which thus
exerts its influence on every part: and (as we shall see)
from the fact of its <u>determination</u> to the cerebral pulp
it appears in addition the function of the nerves springing
from that centre. The tendency is for it to be eliminated
& this takes place by the lungs, skin & principally by the
kidneys. A fit of intoxication is often observed from during
sleep when large quantities of alcohol are thrown out in the
breath. In the urine however the greatest amount passes off
and it may be got rid of more abruptly by vomiting.

In the only fatal case of acute poisoning by alcohol I
remember the post-mortem phenomena usually described were
observed. The lining membrane of the stomach was of a dusky
red colour, this being confined to that organ alone, and more
apparent towards the pyloric orifice beyond which it did
not occur. When the skull-cap was removed a decided
spirituous odour was felt. There was no hypertrophy of
the membranes or inflammatory adherions but the brain
was much congested and there was a large amount of
exuded fluid below the arachnoid and in the ventricles.
That in the lateral ventricles was found by the usual tests
to contain a large proportion of alcohol +

We will now consider scientifically the action of alcohol on the
tissues of the body and on the various organs, when introduced

Direct absorption.

When introduced
into the stomach either in a large dose or in repeated
small doses. It must be borne in mind that liquids
generally and a liquid like alcohol specially, do not
undergo the chemical changes to which solids are subjected
when taken into the stomach. Instead of being subjected to
the action of the saliva in mastication & the various gastric
and intestinal juices, in short: undergoing the operation of
chylification - they pass directly into the blood by a
simple act of endosmose. There is an anatomical fact
in reference to the position of the gastric absorbents upon
which superficial ulcers is not laid, and which indeed is
often overlooked. I would wish to call attention to the relations
of the lacteals and the blood vessels in this locality.
The gastric vessels (from the division of the celiac axis) run along
the two curvatures of the stomach to supply the coats. Run between
them. They then divide into small branches in the sub. mucous
areolar coat and pass between the tubuli & ramify on the
surface of the mucous coat. The absorbents form a network
between the areolar muscular coats & between this layer of
lacteals & the internal surface come the tubuli (gastric or
peptic according to the difference of their epithelial lining).
On examining microscopically injected sections of these structures
we see the capillaries forming minute loops which run up

Actions on the Blood

which run up
between the tubuli and distributed in the mucous lining close to the surface. I have not met with a preparation demonstrating the existence of lacteals in this situation, and I believe no trace of them has been seen. As they are deeper that is with the whole thickness of the secreting structure between them and the internal lining of the stomach, and this points to the greater facility of the passage of alcohol directly into the blood. This it does and that in a less altered condition than it would be were it acted on by the secreted juices.
It is then carried by the coronary, superior mesenteric & splenic veins by the vena portæ through the liver to the heart, thence to the lungs & what is not eliminated is carried back to the heart from which it is distributed in the arterial blood to all parts of the body. Thus it circulates comparatively unchanged in every part and in every organ of the body which are thus doubly affected by the actual presence of the poison in them and then an irritated brain which in course of time may become badly nourished and have its functions impaired.
The action on the blood itself is deteriorating. According to Virchow and German pathologists generally the development of the red corpuscles is arrested and their decay hastened. They consequently lose their vitality & nutritive power. In confirmation of these views I have examined the blood of persons suffering from debility thro' excessive

Fatty degeneration

thro' excessive
indulgence in alcohol, and I have found a departure from the normal condition of forming into rouleaux, with an increase of white corpuscles. In a case of cirrhosis of the liver as many as 14 colourless corpuscles were to be seen at any time in the field of the microscope, while fatty molecules were ~~to be~~ found ~~in~~ the liquor sanguinis & the corpuscles themselves were fatily degenerated and the alkalinity of the blood was increased. In this condition the blood is less able to take in oxygen & give out carbon & it is easy to understand that thus it arrests the renewal of tissue and retards the carrying away or metamorphosis of waste tissue. Thus we may question if the exhibition of the anti-septic action of alcohol is desirable since it is degenerate tissue which is retained.

Its action on the tissues generally. Alcohol tends to produce fatty degeneration of the tissues and this is the most constant result. Not only do we find muscular tissue voluntary and involuntary thus metamorphosed but every tissue and organ is more or less subject to it, brain, heart, liver, kidney &c. This process as is well known is classed under the pathological head of impaired nutrition & consists in the transformation of the albuminoid constituents of the tissue into fat. It is in the heart that we most frequently meet with this as caused by alcohol. In appearance a heart thus affected is uniformly paler or has pale spots throughout its substance. To the feel

Selective & accumulative action.

On the train.

To the fore

it is soft and friable & flabby. Microscopically the fibres are seen to have lost their striated appearance, and contain fat granules. (In advanced stages the sarcolemma is free of large molecules of fat and oil globules). In the kidney & liver it first makes its appearance as small granules in the cells, then the nucleus and cell-wall are destroyed. In the brain it is met with in the condition commonly called "Softening of the Brain" & in the arteries it is also met with as a rule beginning in the connective tissue cells of the internal coat.

Like many medicinal remedies which not only act thro' one particular channel but are determined to one particular locale alcohol has an inherent power of selecting a particular organ and tissue for the seat of its special operation and it is now well known that it fixes on cerebral matter by this peculiar selective power. This has been found by French pathologists to be twice as great for the brain as that for the liver where next in order it is found to accumulate. A post-mortem examination of the brain of persons used to a long continued over-indulgence in alcoholics shows a congested state of the capillaries of the cerebral substance & of the vessels of the meninges. These vessels when repeatedly brought into this condition not being able to rid themselves of the engorgement in the usual way, are relieved by serous exudation into the areolar spaces below the arachnoid membrane and into the cerebral ventricles. This naturally sets up

Alcoholism

sets up
a great amount of cerebral irritation & consequently all the important functions of the body are interfered with. In this congestive stage apoplexy and epilepsy may occur & if it passes on to the inflammatory stage, delirium tremens, convulsions, shaking palsy, paralysis are likely to result. As small doses long continued, of certain agents e.g. Lead, Arsenic & Mercury produce at first no noxious but even a beneficial result & ultimately a condition of plumbism, arsenicism & Mercurialism, so oft-repeated indulgence in alcoholic drinks produces an action which because it is brought on by nothing else is specific, and the resulting constitutional condition is call alcoholism. The actual presence of alcohol in the brain has been referred to in a case of acute poisoning. How precisely the same localization takes place when it is used in small doses, continuously and repeatedly. As in acute cases it selects brain, so does it in chronic. It is not entirely eliminated from the system but a certain amount remains behind & that chiefly in the cerebral pulp where each fresh dose produces a like accumulation. This poisoning of the grey matter of the brain develops a constitutional condition invariably similar in every fresh case and attended by phenomena of uniform character & course. There is a fact confirmatory to the view of its being accumulative. There is no drug whose action is so much modified by habit. A person habituated to its use both becomes very much less susceptible to its action & that we would

Alcoholism.

we would

expect him to become in time insensible to its stimulating or rather exciting effect; and this is the case. He may go on for a long period gradually increasing his daily allowance with no perceptible effect. No apparent evil result; until a certain stage is reached. This is when it has accumulated to the extent that his whole system is charged with it until in fact he is alcoholised. When this stage is reached, a very much less quantity will produce an equal or even greater result than the larger amount previously indulged in. That the whole system is as it were saturated with the poison is manifest from the familiar example of the obstinacy to heal of the most trifling wound or even abrasion of the skin where this exists in a person thus alcoholized & the unfavorable nature of any pre-existing sore or ulcer in whatever part of the body. Every house surgeon knows how liable scalp wounds in drunkards are to take on erysipelatous action. Proof may also be taken from the dangerous & acute character which inflammatory diseases assume & the great liability such patients have to succumb to attacks of fever &c. Having thus determined that alcohol by acting on and accumulating in the cerebral tissues, and by disturbing the function of the sensory, produces such a condition of system that a smaller quantity will produce a more intense and lasting result, let us consider the more important diseases induced by this condition and first in rank comes Delirium Tremens.

Delirium tremens.

This disease may be defined as one of the manifestations of the specific toxicological effect produced by long continued and often repeated doses of alcohol. It is brought on solely by over indulgence in alcoholic drinks which have been shown by Dr Craigie & Peddie to be not only the pre-disposing but the directly exciting cause. After the able writings of such authors little remains to be added to their observations except to confirm from cases in the pathological theatre that the primary lesion is in the cerebrum itself, & that this organ is not sympathetically affected thro' the solar plexus by the gastric disorder.

The premonitory symptoms are digestive derangement - foul tongue, & constipation - moist skin, scanty urine, & pulse high & small. There is also restlessness & a nervous irritability of manner, with a cessation of the desire to drink. The symptoms which follow are well known and are sleeplessness, muscular tremors of the hands & tongue, and twitching of the facial muscles, and the delerium which is characteristic being not violent but busy & abrupt & apprehensive. The hallucinations of sight & hearing are also constant and the anxious expression of face is marked. Dr Craigie considers that these phenomena are due to the condition of the blood sent to the brain & contained in the meningeal & cerebral vessels. These as we have seen are full of alcoholic particles & the blood is imperfectly aerated. This is no doubt the pathological condition during the premonitory & first stage but an opportunity of examination at this time is seldom afforded. In post mortem examination of

Pathology of delirium tremens

Delirium ebriosum

examination of
fatal cases where the characteristic delirium & hallucinations have supervened we naturally expect to find some thing more than signs of more cerebral irritation. In such I have observed hyperæmia of the membranes especially of the arachnoid with inflammatory adhesion to the other membranes of the dura mater to the skull & of the pia mater to the brain-substance. In some cases in attempting to strip this last from the convolutions portions of the cerebral pulp came away. The cerebrum itself is usually friable & the convolutions are shrunk. These conditions along with opacity and fibrous character of the membranes we would only expect to notice in cases where history showed excessive drinking protracted over a long period. The affection is not only sub-arachnoid and vascular but into the cerebral substance itself.
The theory that the sudden cessation from the usual stimulus was the direct exciting cause of delirium tremens has exploded. It arose from the fact that one of the premonitory symptoms is the gastric derangement and an aversion to drink is produced. On account of this the subject has for some time previous to the exhibition of the more apparent symptoms entirely given up his usual potations.

Delirium ebriosum is another form of disease to which the abuse of alcohol may lead. It is caused by heavy drinking for a short period until a fit of mania is produced. When this is manifested the desire for more strong drink is so strong as to lead the patient

Delirium traumaticum

lead the patient
to perform dangerous & violent acts in order to obtain it.
The delirium is wild and raging, muscular tremors are usually present. the skin is dry & hot & the pulse is strong & high. These symptoms are popularly supposed to be those of delirium tremens but they are quite characteristic of this form of mania as we may call it which also differs in pathology & treatment from delirium tremens. In this the patient must be put under restraint while in delirium tremens restraint must not be employed as it increases the irritation may induce a tendency to violence. The expression of face in each is distinctive. In the one it is anxious with a look of expectant dread, while in the other it is sullen & fierce. The pathological condition can only be guessed at — the symptoms point to a great amount of vascular excitement — but the cerebrum is not so full of alcohol as in delirium tremens, in fatter livers the state of alcoholism is not developed. In this form as in delirium tremens, Nature tends to produce recovery. The strong craving for more drink when yielded to produces nausea & vomiting after which rapid recovery takes place. In delirium tremens as we have seen there is no desire for drink & more used aggravate the symptoms & prolong recovery, thus we are guided to treat without stimulants.
A febrile attack with delirium of a low typhoid type is sometimes induced as the result of a surgical injury in a patient who has been

Action on the stomach

who has been
in a state of alcoholism at the time. This is the delirium
tremens of Dupuytren. I have not met with a well defined case.

It would be a needless task to enter into the symptoms
and pathology of the many diseases resulting from the action
on the nervous centres of alcohol. Suffice it to say that among
the most frequent are apoplexy, epilepsy, the various cerebral
softenings (giving rise to paralysis), convulsions shaking palsy & insanity.

Space does not admit of the consideration of the diseases
in the various organs induced by the abuse of alcohol, for each
is a study in itself. I shall only mention some of the most
important met with, and first those of the stomach.
From the irritant action of alcohol and from the fact that
dram-drinkers frequently indulge on an empty stomach it is easily
seen that a certain amount of inflammation will be set-
up after each dose. Dr Braumarts experiments on St Martin
showed that the contact of alcohol with the walls of the
stomach was followed by an increased secretion of fluid
which he found was not gastric juice but the ordinary
mucus. This direct irritation with congestion and stimulation
to increased secretion results in chronic gastritis which
soon produces thickening and induration of the coats.

This I have noticed with narrowing of the
pylorus but never to the extent of ulceration and

Action on the liver

Cirrhosis.

Pathology of Cirrhosis.

alteration &
perforation as is sometimes described, we have seen
a case of gastric scirrhus as usually pass thro
directly exciting cause.
The liver as we have noticed may, in common with
the tissues of other organs, become fatty degenerated
one of the results of impaired nutrition but there is
an affection of a chronic nature met with in this
organ, which must not be passed over. Refer to Cirrhosis is
This is, in short: a chronic inflammation of the areolar
tissue in the interstices of and covering the organ
we have seen that alcohol is directly absorbed and
is carried by the portal vein thro the liver. Thro I
am inclined to agree with those who hold that this
affection is due to the direct irritation of alcohol
in the liver. The pathology is interesting.
At first the organ is congested & consequently enlarged
This congestion occurring intermittently, alternately
compresses and relaxes the hepatic lobules. The inter-
-stitial connective tissue being thus subjected to non-
continuous irritation and pressure becomes hypertrophied
& consequently contracts drawing the capsular ligament
with it so that the surface is irregular, and hence
the term "hob-nailed" liver. At this stage the whole

Case of cirrhosis of liver

the whole
organ becomes contracted and smaller. Many important secondary symptoms result from this contracted condition & obstruction to the circulation, such as dropsy of the limbs, ascites, enlargement of the Spleen &c.
A well-marked case in this hospital was for some time under my care. Patient was an Englishman in a brewery and was in the daily habit of imbibing large quantities of sweet ale and that generally when there was no food in the stomach and when he was heated and perspiring freely so that there was every facility for the alcohol being rapidly absorbed and exerting its influence on the tissues & on the liver especially. His first symptom was failing eye-sight immediately followed by yellowness of the conjunctivae and other indications of jaundice. Some days after this he complained of pain in the right hypochondrium. On admission the liver was found to be enlarged, & painful on palpation. The area of dullness in the mammillary-line was six & a half in. & there was considerable ascites, the circumference of the abdomen at the umbilicus being forty-two inches; & the patient also suffered from nausea & vomiting. The interesting features of the case were the secondary affections, as the dropsy of the abdomen & the limbs and the enlargement of

enlargement of
the spleen. Four weeks after admission when the
condition of the liver had been subdued and
the organ lessened till the area dullness was about 5 7/8 in
by the external application of iodine and other means,
the ascites increased considerably. This was undoubtedly
owing to the circulation being more obstructed from
hypertrophy of the connective tissue & compression of
the vessels and cells. The spleen also was found to
be enlarged to about 5 3/4 in. from the upper to the
lower end, and there was a marked increase
in the number of the pale blood corpuscles. As
many as from 14 to 16 of these colourless discs were
to be seen at a time in the field of the microscope.

The remaining diseases affecting the digestive system
whose origin may be traced to the abuse of alcohol
are numerous. At first dyspepsia & constipation
result, the latter owing to diminished secretion and
increased alkalinity of the blood, but later if
ulceration of the stomach or intestines to perfo-
rations is the result. In the kidney we find
fatty degeneration, & as a rule this begins in the
capillaries of the Malpighian bodies. In the urine
albumen & phosphates exist to a great extent and.

great extent; and
diabetes is not unfrequently met with.
In short, by the long continued over dosing of alcohol
the nutrition of the whole system is impaired and the
vitality is consequently lowered, & that before any organic
lesion exists there is great functional derangement.
In this state if there is as it were any demand
for increased exertion on the part of an organ
it is unable to perform its function or the per-
formance of it is followed by organic disease.

I shall conclude with a quotation from Ruddle "on
the treatment of Delirium tremens without stimulants or opiates."
"No habitual & excessive use of intoxicating liquors however does not
affect all individuals alike. Some drinkers are rarely attacked by diseases of
the brain liver or other organ to which they may have a hereditary or con-
stitutional liability; others by fevers or inflammation which
they have no stamina to contend against; others by
apoplexy or paralysis from the direct effects of a
debauch; & some from hereditary predisposition or other-
wise are rarely doomed to spend the remaining years of a
miserable existence in mania (idiocy or in a general
paralytic condition of the system. Some few drinkers
again by reason of extraordinary constitutional vigour
escape all these ills and live on to old age.

but the greater number who are not early removed from society by the disease communicated suffer more or less from attacks of delerium tremens."

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University of Edinburgh Ap. 1878.

Edinburgh April 1878.