ALCOHOL AND PHYSIOLOGY

BY EUGENE LYMAN FISK

I

THE opponents of alcohol as well as its apologists have always been prone to injure their arguments by exaggeration. The postulate that the alcoholic is always a defective is no more sound than the postulate that the criminal is always a defective. No man is perfect, and while a mental or nervous defective of a pronounced type is usually, though by no means always, an easy victim for alcohol, what alcohol will do to individuals far above this line is often a matter of circumstance and environment. I have seen men with bad inheritance and many stigmata of nervous instability, develop, under proper encouragement and suggestion, a successful resistance to alcohol, and build up will-power and self-control; while on the other hand, I have seen men with good endowment, — men who by no stretch of the imagination could be considered defective in a pathological sense, — buffeted by fate, tempted by environment, and prodded by suggestion, gradually yield to the steady use of alcohol — sometimes to complete downfall, sometimes to woeful lack of achievement. Every reader of this magazine can call to mind many fine men who have fallen by the wayside through alcohol, — men whom it would be scientifically ridiculous to call defective.

After all, who are the 'defective'? Where shall we draw the line? Who are the perfect men, these men who are above all manner of temptation, for whom alcohol is innocuous? While there are many men who have inherited or acquired a stability of mind or nervous system that doubly assures them against attack, I have yet to see the man for whom the more or less steady use of alcohol did not carry some menace. In fact, we are considering the mass of the people, and not exceptional types such as the common drunkard, the insane, or the super-man. Among the mass of the people circumstances plus alcohol often constitute a dangerous combination; and alcohol often is responsible for the circumstances that make it dangerous.

The naïve assumption that alcohol impairs only the fundamentally unfit will not bear analysis, and the development of such a hypothesis into such theories as those of Archdall Reid, who holds that alcohol, by weeding out the unfit, acts as a beneficial evolutionary influence, may easily be carried to a *reductio ad absurdum*. Such arguments apply with equal force to plague, yellow fever, consumption, pneumonia, and the other communicable diseases, as it is well known that those of low resistance usually succumb to such diseases. Let us then allow them full swing in order to eliminate the non-resistant! The problem of the survival of the unfit must be met in other ways consistent with modern science and altruism, and not through the aid of the corner saloon.

The question as to what the effects might be upon a group of men controlled in such a way that the influence of

so-called moderate drinking could be restricted to the degenerative or toxic effect on organic tissue, while the individuals are protected from life's vicissitudes, is almost purely academic. It could never be duplicated in real life. A group of insured lives must be considered in the moving equilibrium of actual workaday existence, and the many varied relations of that existence to the more or less steady use of alcohol in the quantities used by the mass of the people who drink, must be the touchstones applied to the life-insurance statistics presented in the previous paper.

We must bear in mind that even so mild an indulgence as one or two glasses of champagne or beer three times a month would, in the course of twenty years, make seven hundred and twenty exposures to alcoholic temptation, in addition to whatever disturbing effect on the moral, psychic, or physical condition such doses may have. Among two million individuals, even such slight indulgence would mean, in the course of one year, seventy-two million exposures to such varied adverse effects as there may be in small doses. Among those drinking every day two glasses of beer, the exposures to temptation and to further drinking among two million men would be in the course of one year seven hundred and thirty million, and in twenty-five years eighteen and a quarter billion.

Eighteen and a quarter billion exposures to alcohol might be compared to very distant artillery fire directed at an enemy. Many thousand shells are fired to produce a few fatalities. Many fail to hit, but in the long run there is a definite fatality. The impact of eighteen and a quarter billion doses of alcohol on a group of two million men must certainly place the group at a disadvantage as compared to a group that is not exposed to such impact, provided of course that we find that the total effect of alcohol in the doses usually taken as a beverage is ever so slightly injurious in a direct way and carries any distinct danger of temptation to increased indulgence to the point where common observation shows it to be a deadly, destructive poison. What is the evidence along these lines?

Is there any sound reason to suspect alcohol of being the underlying cause of the greater part of the extra mortality unquestionably obtaining among users as compared to non-users? If we were confronted by an experience with users of ether or chloroform compared to non-users (ether is widely used in East Prussia, not a prohibition state), should we for one moment question the fact of these drugs being the essential poisonous agent? Even though used in moderate quantities, should we question that cocaine or morphine or hashish or any other habit-forming drug was the chief factor in any extra mortality shown by its users? Only well-supported evidence showing that alcohol in the average quantities used by so-called moderate drinkers produces no bodily ill effects, either directly or indirectly, could justify seeking any other explanation than the influence of alcohol to account for the trend of mortality in the life-insurance experience.

Is there any well-supported evidence that the drinking of the average man is harmless? The laboratory must answer this question.

The most important work that has yet been done in the study of alcohol is that of the Nutrition Laboratory of the Carnegie Institution in Washington, under the direction of Professors Raymond Dodge and E. C. Benedict.

The work of Benedict and Atwater in establishing the fact that small amounts of alcohol, not to exceed 2.4 ounces daily, are completely oxidized in the body, and that by its tissue-sparing qualities alcohol may theoreti-

cally take the place of food, is well known. It is not so well known that Atwater condemned the use of alcohol as a food because of its cost and its possible ill effects on the nervous system.

Desiring to carry further these researches, a very elaborate plan has been outlined by Professor Dodge. The immense and comprehensive scope of the investigation planned may be judged by the fact that the physiological division of the research, as tentatively laid out by Dodge and Benedict after conferences either by letter or in person with the leading physiologists and research workers of the world, includes seven main sections and one hundred and sixty subdivisions.

The psychological programme, which has already been carried out with the coöperation of Dr. F. Lyman Wells, includes four sections, covering an investigation of the effect of moderate doses of alcohol on the simpler reflex nervous mechanisms in the lower levels of the spinal cord, and also tests of its effect on certain higher and more complex functions, as well as on memory and free association.

Benedict rightly says, with regard to the important higher mental and moral processes, 'There is at present scant probability of securing experimental data of scientific reliability, owing to the difficulty of measuring them in any direct way. This technical defect is a serious limitation to all experimental investigation of the psychological effects of the ingestion of alcohol, since it is precisely in these directions that our general and scientific experience indicates that the effects of alcohol are most serious.'

For example, the effect of alcohol on the mental processes of a subject quiescent in the laboratory, where it is impossible exactly to reproduce the conditions under which alcohol is usually taken, may be different from what they would be in social life. In convivial company there is a certain relaxation of control of the higher centres and a reinforcement of the lower centres which may reverse the effects of alcohol as shown in the laboratory. In working with small doses of alcohol we are operating within very narrow margins, and manifold factors may disturb the equilibrium of the experiment, even apart from varying individual susceptibility. It is well to bear this in mind in interpreting the facts just given to the public in the voluminous report of the Nutrition Laboratory.

The report is couched in rigidly technical and formal language, giving in detail the technique and results of the experiments. It is free from any suggestion of propaganda, either scientific or sociological, and practically free from any discussion of the application of the knowledge in the solution of the alcohol problem.[1]

II

Before proceeding to a summary of the results of these experiments it is desirable to state briefly the evidence previously presented by the world's leading investigators and note to what extent it is confirmed by the Nutrition Laboratory with its wealth of scientific apparatus, some of which, such as the electrocardiograph, has only lately become available for research work and has added much to the delicacy and precision of the psychological measurements.

The most important work along these lines has been done in Germany,

[1] The investigation is planned to cover about ten years in time, and premature generalizations are distinctly avoided. Nevertheless, there is presented exceedingly important and definite evidence of the effect of alcohol in moderate doses, which has very significant bearing upon the interpretation of the life-insurance statistics. — The Author.

and it is there that scientific opposition to the use of alcohol is strongest. Kraepelin and his pupils have contributed most to our knowledge of the psychological effects of alcohol; they have done much to dispel the dogma that alcohol possesses stimulating properties and have plainly labeled it a narcotic. The work of Kraepelin, Kürz, Aschaffenburg, and others, has shown a distinctly narcotic or depressing effect from even small doses, such as a half to a whole litre of beer. A distinct impairment of the power to memorize numbers was found after the consumption of two to four glasses of beer. Habitual association of ideas and free association of ideas were also interfered with.

Vogt, of the University of Christiana, in comparatively recent experiments on his own person, confirmed the results of Kraepelin and Smith, and found a reduction of 18 per cent in the power to memorize Greek poetry. Six months later, when the poetry was reviewed, it was found that the lines learned on alcohol days were less readily relearned, thus suggesting the hypothesis that they were less clearly impressed on the memory while alcohol was circulating in the brain. Vogt found that about 15 cubic centimetres (four teaspoonfuls) of whiskey on an empty stomach, or 25 cubic centimetres with food, distinctly impaired the power to memorize.

Aschaffenburg found that moderate doses of alcohol lessened the amount of work done by printing compositors and increased the liability to error. In his and Kraepelin's experiments, the reaction time, or the interim that elapses between an irritation and a responsive movement, which can be measured within one one-thousandth of a second, was at first shortened under small doses of alcohol and later lengthened, suggesting a depression of the higher inhibitory centres and a release of the lower nervous mechanisms, with an acceleration of action characterized as 'premature.'

The testimony as to the effect on muscular efficiency and fatigue is somewhat conflicting, owing to the varying susceptibility of the many individuals used in the tests. Such workers as Dubois, Schnyder and Hellsten have found a total loss of working power, occasionally preceded by a temporary increase, variously ascribed to primary increase of interest, temporary stimulation or even temporary paralysis of the higher centres, resulting in acceleration of the lower. Experiments with the ergograph — an instrument for recording the value of work done by muscular contractions — showed that any apparent stimulation was reflected in an increase in the number of movements, but not in their force or range, giving some support to the view that the effect of alcohol was a release of susceptibility or irritability rather than a driving force.

Rivers, in 1908, noted the discrepant findings of various investigators, and was inclined to view the results of previous experiments as seriously affected by the personal equation and accessory factors other than alcohol, and by lack of proper checks and controls.

His own carefully checked and controlled experiments had failed to show, on the whole, any stimulating effect on muscular efficiency from moderate doses of alcohol — 20 to 40 cubic centimetres. (Four cubic centimetres are equal to one teaspoonful.) He states that sometimes a dose of 40 cubic centimetres of pure alcohol may produce a decided increase in the amount of work executed with the ergograph, but at other times the increase may be wholly absent and may possibly be replaced by a decrease.

With regard to mental work, Rivers concluded that the available evidence

pointed to a decrease in the amount of work under the influence of alcohol, when there is any effect at all; but there are great individual differences. The analogy between the effect of mental fatigue and the effect of alcohol on muscular work is a striking feature of Rivers's work, and supports the view of Kraepelin that the effect of alcohol is essentially central, acting directly on the brain and spinal cord.

The dulling of mental activity by fatigue is compared to the dulling of mental activity by alcohol; and the increased muscular activity noted by Rivers on his own person following mental fatigue is likened to the muscular activity sometimes noted after doses of alcohol.

The fact of wide variation in individual susceptibility is a matter of extreme importance in explaining the unfavorable effects of alcohol on large masses of men. In such masses will always be found a very large percentage of people who react unfavorably to it, as such subjects are always found in the small groups that have been selected with great care as supposedly normal subjects for investigation.

Also, as Rivers suggests, the similarity between the action of alcohol and that of fatigue should make one very chary of concluding that any stimulating effect of alcohol on muscular activity is an indication of a physiological action which is beneficial to the organism as a whole, even in those supposedly favorable subjects where it is found to occur.

With regard to muscular efficiency, Quensel says of the investigations already mentioned that they 'afford a full objective support for the truth of what practical experience teaches. From the sporting and military life many experiences are at hand which demonstrate the undesirability of using alcohol when the point is to keep the body for a longer period at its greatest point of strength and endurance.

'Experience has furthermore shown that it is difficult and responsible work which suffers most from the influence of alcohol. Endurance, energy, concentration, suffer in the first place, while ability to execute an already familiar piece of work, or purely mechanical occupations, are inhibited to a far less noticeable degree.' The danger of increasing indulgence being also freely admitted, it is difficult to understand his point of view that moderate indulgence in alcohol as a source of relaxation after work or fatigue is not to be condemned from the hygienic point of view.

The indictment which Quensel himself brings against the use of even moderate doses under ordinary circumstances does not consist very well with his indorsement of it as something to play with in relaxation. A wild animal that must be watched is no very safe playfellow, and the record of alcohol in its influence on mankind certainly justifies the claim that it needs watching.

William James aptly characterized the psychic effect of alcohol as that of 'narrowing the field of consciousness.' Expansive as the drinker may feel, his intellectual world is restricted by alcohol, according to common observation and the testimony of many unprejudiced brain-workers. The man who leans on alcohol cannot, of course, do creative work without it until he is put in a normal condition; but there is little evidence that alcohol releases any higher mental activities, unless we except the case of the psychopath, whose brain cannot function without the drug upon which it has become dependent. This will receive further consideration in discussing the findings of the Nutrition Laboratory.

Another important system to consider in its relation to alcohol is the so-

called 'autonomic system,' the nervous mechanism for maintaining in equilibrium the circulation of the blood, the activity of the heart, and the tone of the blood-vessels, as well as other glandular and organic functions. The most extensive use of alcohol in medicine has been that of a heart stimulant. In every form of heart-failure, whether of acute shock or the depression of acute illness (especially in typhoid and pneumonia), alcohol was formerly a standard routine remedy, to be used on the first signs of a falling circulation, in traditional tablespoonful doses at intervals of several hours, and occasionally in much larger quantities. We now know that such value as it possessed in acute illness was largely due to its fuel-value, to its property of sparing tissue and thus replacing nutrients in the diet which were often mistakenly withheld in the graver stages of acute illness.

While there are still a few authorities who believe that alcohol has some beneficial effect on the circulation, in spite of its absolute failure to show any value as a direct heart stimulant, the pendulum has swung very far in the other direction, and alcohol is now seldom used in acute illness except as a substitute for food and in cases where previous steady drinking has made it unwise to withdraw it. Crile, Cabot, Dennig, Hindelang, Grünbaum, and others, have failed to show any increase in blood-pressure from its use in therapeutic doses in man. Although very small doses in animals have shown some slight stimulating effects, the depressant after-effects are very quickly reached. Blood-pressure, however, is not an infallible test in this regard, and there is other evidence to show that alcohol not only depresses the nervous centres controlling the tension of the blood-vessels and thus lowers blood-pressure, but depresses the inhibitory nervous centre that controls the rate of the heart, thus accelerating the heart beat without adding to its power. It takes the 'brake' off the heart, but adds nothing to its driving force.

As a food, too, it is discredited in acute disease, and substances like sugar are now employed as affording almost equal fuel value without the possible dangerous effects on the circulation and nervous system. The 'high calorie' diet in typhoid, for example, now elbows alcohol out of the sick-room, even as an alleged emergency food.

On the protective qualities of the blood, its complex and as yet only dimly understood mechanism for resistance to infection, alcohol exerts very definite effects. While there is much conflicting evidence, there has grown up, not only a clinical aversion to the use of alcohol in such conditions as tuberculosis and other infections, but a body of evidence justifying this reversal of former clinical practice.

Fillinger found the resistance of the red blood-cells much reduced after administration of champagne to healthy human subjects, and similar results were found in dogs and rabbits. Weinberg confirmed these results by similar methods, showing that 20 per cent of the red cells lose their resistance after the administration of 450 cubic centimetres of champagne. Little effect was found on the white blood-cells by Parkinson in a series of careful tests, except when very large doses were continuously taken: that is, the power of these cells to destroy bacteria (phagocytosis) was not materially affected.

Laitinen was convinced that very small doses, 15 cubic centimetres, for instance, distinctly lowered the resistance to typhoid after prolonged administration. Muller, Wirgin, and others have shown that alcohol restricts the formation of 'antibodies' (the function of which is to resist infection) in

the blood of rabbits. Rubin demonstrated that alcohol, ether, and chloroform, injected under the skin, render rabbits more vulnerable to streptococcus (blood poison) and pneumococcus (pneumonia) infection.

Our knowledge on the subject has lately been reinforced by Reich, of the University of Munich. He failed to show any increase of protective activity (phagocytosis) against tubercle bacilli in the white blood-cells of abstainers as compared to alcohol users, but noticed that phagocytosis of typhoid bacilli by the cells of abstainers was more readily effected. The bactericidal qualities of the blood serum of abstainers were also more active against typhoid bacilli. Furthermore, the resistance of red blood-cells to salt solution was lowered in proportionate relationship to the degree of alcoholic indulgence. Laboratory or clinical evidence is of course lacking as to the effect of small doses of alcohol on the kidneys, liver, and the structure of the blood-vessels. Such minute and chronic changes as there may be cannot be readily ascertained by such investigations, and we must draw our conclusions as to the probable effect of continuous so-called moderate drinking on these organs from the well-known effects of excessive drinking in bringing about degenerative changes in the liver, kidneys, and blood-vessels.

It is possible that light may be thrown on this matter by the researches of the Nutrition Laboratory. From the insurance experiences we are at least justified in assuming that even the moderately drinking classes are more subject to these chronic organic affections than those who abstain.

So far as the direct action of alcohol on the stomach and its functions is concerned, there is little evidence that in dilute solution (less than 10 per cent) it exerts any restraining influence on digestion. Indeed, its use tends to encourage over-feeding and add excessive food-consumption and absorption to the fuel-value of alcohol. Indirectly, it may thus tax the digestive system, and by causing undue accumulation of weight, — especially among beer-drinkers who drink to excess, — add the peril of obesity to that of the toxic effect of alcohol on brain and circulation.

It may be asked why, if alcohol thus promotes nutrition, it is not serviceable in wasting diseases. The answer is that the price paid in toxic effect is too high. The unfavorable influence already noted on the brain and blood and circulation counterbalances its food-value for those who need to gain weight, and for those who are already in the heavy-weight class it is a double handicap.

In the past few months further light has been thrown upon the alleged food-value of alcohol. The one great therapeutic stronghold still held by alcohol is diabetes. Even Ewald, and others strongly opposed to the use of alcohol generally as a therapeutic weapon, concede its value in this disease because of its alleged action in preventing the development of acidosis when starches and sugars are withdrawn or greatly reduced in the diet. That this view is based on dogma and not on scientific fact has lately been shown by Higgins, Peabody, and Fitz in their experiments at the Carnegie Institution and at the Peter Bent Brigham Hospital, where carefully controlled experiments on normal human beings showed not only an absolute lack of 'antiketogenic' or acidosis-preventing influence on the part of alcohol, but an actual acceleration of such conditions by its use, the measurements being made by the most delicate and accurate methods available to science (oxygen tension of alveolar air).

This evidence concerns normal people

as well as diabetics, because the trend of modern diet is toward the over-use of acid-forming foods, such as eggs, meat, fish, cereals, and an insufficient use of base-forming foods, such as most fruits and vegetables. Those who eat inordinately of these concentrated flesh foods and also drink alcohol, are increasing the tendency to acidosis, a condition which in its milder form is often given the absurd misnomer of "biliousness." [Bile never has anything to do with the symptoms usually charged against it.]

Without going further into the physiological and psychological effects of alcohol as ascertained, we may sum up the evidence prior to Dodge and Benedict's researches by stating that alcohol has been found to be a depressant, a narcotic, often exerting, even in small daily doses, an unfavorable effect on the brain and nervous functions and on heart and circulation, and lowering the resistance of the body to infection.

[*In a concluding paper Dr. Fisk will discuss laboratory tests dealing with human efficiency and alcohol.* — THE EDITORS.]

THE CULPRIT

BY FLORENCE CONVERSE

I

THE postman came out of the cobbler's shop on the morning of Columbus Day as Officer Harrigan was going in.

'Fine weather for the parade,' the postman said.

'Dago luck!' growled Officer Harrigan. 'Remember the hell-of-a-blizzard we had on the seventeenth of March?'

The postman's answer was lost down the alley between the cobbler's shop and the paper-box factory. There was a tenement in behind, where twelve Italian families, including the household of Angelo the cobbler, reproduced the atmosphere and sanitary conditions of certain quarters in Naples. The shanty shop, blocking the alley, toned in admirably with the local color.

Inside, Angelo and his pretty Giuseppina hung in perplexity over a long white envelope which the postman had left on the cobbler's bench. At intervals they pawed it gingerly, turned it over, turned it back again.

'Will I read it for yez?' volunteered Officer Harrigan.

'An-ge-lo Martini,' said Angelo. 'I read my name aw right, — but —'

'W'at make a bird here?' queried Giuseppina.

'P-h-o-e-n-,' murmured Angelo.

'I-x,' continued Officer Harrigan. 'You been takin' out fire insurance?'

Angelo fixed large, dazed eyes upon the policeman's face: 'Fire insure —? Yes.'

'Well, this here 's it.'

Angelo's eyes sought the envelope. 'P-h-o-e-,' he murmured again.

'Feenix, you son of — Columbus,'