1940

Certain physiological effects of tobacco smoking

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Boston University

http://hdl.handle.net/2144/5413

Boston University
BOSTON UNIVERSITY
SCHOOL OF EDUCATION

Thesis

CERTAIN PHYSIOLOGICAL EFFECTS OF TOBACCO SMOKING

Submitted by

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(B.S. in Ed., Boston University, 1939)

In partial fulfillment of requirements for
the degree of Master of Education

1940

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INTRODUCTION

It is hard to be a health educator, and not be concerned with most of the habits exercised by young men and women. To keep an open mind in the face of countless advertisements, personal opinions, and pre-judiced scientific statements, is not easy to do. It leaves the thinker in a frustrated state. Because the writer was left with that feeling, this study was undertaken. That excessive smoking is beneficial, or even harmless, is hard to believe.

There is another motive behind this discourse. Roger Babson, the famous statistician, recently said, "When America's keenest minds are using the newspapers, magazines, movies, and radios to entice youth to drink whisky, smoke more cigarettes, and make heroes of criminals, those youth should have the other side of the argument from someone."

The attempt to bring together much of the experimental results in the field of tobacco smoking, has not been done recently. What work has been done, has been laid away where the schools would not normally find it. Each experimenter, a specialist in his own field, reports to his own specialized and highly scientific journal. Thus, only as health educators "dig" into the cumulative index for these individual reports, and "unbury" and bring to attention the facts, will the truth be known to more than the man who discovered it.

The law requires pupils to have a knowledge of the effects of alcohol and tobacco. The desire is present that the truth be taught, but sources in the textbooks are very inadequate and uninteresting.
This thesis is an attempt to furnish information to health educators, physical educators, and classroom teachers, that they may be more enlightened in their instruction. The author has unearthed scientific material, consulted medical men and health educators, and has tried to keep clear of subjective opinions. The thought has been, if smoking is beneficial in the long run - by all means smoke. The writer has tried to remain unprejudiced one way or the other.
TOBACCO AND NICOTINE

Tobacco was discovered in America on the Island of San Salvador by the men of Columbus, and introduced to Europe by a Spaniard (Thevet) in 1517. People at first were persecuted for using it, but as time went on the higher classes adopted it. At the time of the French Revolution the soldiers set the style, and the last World War started the habit among the young people, and particularly the women (32).

The herbaceous member of the Solanaceous family named Nicotania Tabacum (named after Jean Nicot) found in the common cigarette has many poisons, but the most interesting by far is nicotine ($C_{10}H_{14}N_2$). It is soluble in water, alcohol and ether, and turns brown when exposed to the air. That it is a powerful and rapid poison, with only 6 mg. needed to cause death in one human being, is well known (34), (114).

Claims of carbon monoxide poisoning do not seem to be strong enough to warrant much attention. The amount of carbon monoxide in the tobacco depends on the closeness of packing, and the rate of burning. Cigarettes vary from .06 to 1.40 per cent of carbon monoxide (58, 3). In smoking it has been found that about 1.0 per cent of the carbon monoxide reaches the lungs, but breathing takes place several times between inhalations, so that actual absorption of carbon monoxide is much smaller than 1.0 per cent.

Since the tissues of the mouth and lungs are normally moist, they readily catch the arsenic ($As_2O_3$) in the smoke. The findings show,
however, that emptying the pipe before all of the tobacco is gone, finishing the cigar with a sizeable butt, and the same with the cigarette, will eliminate the greatest portion of the poison arsenic. The amount of arsenic absorbed is no more than that permitted by law for food products. (43, 34).

That there are other credited poisons in the cigarette is probably true, but this paper will be concerned chiefly with the most important one from the health standpoint, that is, nicotine. Until cigarettes and tobaccos in general become nicotine-free, they will continue to cause attention. There is, however, a cigarette holder on the market that contains a whole cigarette as a filter of the nicotine. This filter has an aluminum barrel which cools quickly (due to high heat conductivity) and deposits the volatile substances in the smoke within the filter cigarette. The laboratories of the Italian Government Monopoly state that the holder of a single filter-cigarette removes 70.5 per cent of nicotine, and that the one with two cigarettes removes over 93 per cent (45).

Every smoker smokes differently. Some inhale, others do not; some smoke half a cigarette, others a large part; some smoke brands with higher nicotine content, while others think they are smoking "denicotinized" brands. The latter has yet to be found (102, p. 6). Despite these differences, nicotine makes its pathway into the human system.

Much has been claimed for tobacco, long before the present time. It has been said that Bismarck, when discussing smoking with a French Chancellor, said, "You, who do not smoke, have one advantage over me,
you are more wide awake. But you have one disadvantage: you are more inclined to be hasty." (Bismarck, however, was often furious with rage.) It was O'Shea who became so interested, (due to previous confusion at great conventions where educators and scientists alike smoked) that he investigated countless pro and con literature on the subject of tobacco smoking (31). The problem is beginning to take shape.
ANEMIA AND BODY WEIGHT

It is acknowledged that the bone marrow is important in the production of red blood corpuscles, and that these erythrocytes possess a red coloring matter, hemoglobin, which contains more than half of the iron in a healthy adult body. It is further agreed that the hemoglobin carries the oxygen from the lungs to the tissues and cells. More hemoglobin may be created as needed with reserve of iron in the liver, bone marrow, and spleen. Since there are about a trillion new red blood cells a day to be supplied with hemoglobin, the needed iron must be secured from the destruction of the old red blood cells, as well as the liver reserve. This, however, is still inadequate. The diet becomes the focus of attention. When too little iron is taken in the diet, too little hemoglobin is manufactured, and the result is nutritional anemia.

Recent studies show that a reserve supply of iron can be stored in the body if a generous amount is consumed in the food. This means that eating foods which contain iron is essential to proper body functioning. Adolescent girls need excess iron; men seldom have a deficiency, but women have an average hemoglobin content about 10 per cent below the men (menstrual periods), and since many women eat less food because of their figure, they receive less iron, and the result - anemia is more prevalent among women than men (112, p. 198).

Of course there are other causes of anemia besides the malnutritional one. Excessive loss of blood, malignant growths such as tumors,
parasitic plant or animal life, and toxins in the blood are a few examples. But, these are more or less out of the control of the individual. To reduce the appetite for wholesome foods rich in iron (meats, egg yolks, greens) would seem an illogical thing to do.

Tobacco smoking has a great tendency to deaden the appetite. It so happens that smoking reflexly stimulates the flow of saliva in most subjects, according to Schnedorf and Ivy (89, p. 899). Clinicians have noticed that gastric hyperacidity, or over secretion of gastric juice, occurs in heavy smokers (36 p. 77). This may be attributed to the effect of the nicotine on the nerve centers which control secretion. Schnedorf and Ivy have found that tobacco smoke almost immediately stopped the hunger contractions in the stomach. They believe that this was not due to the nicotine, but merely to the smoke. This they proved by nicotine injection, which did not stop hunger contractions as the smoke in the stomach did. Whatever the irritant in the smoke was, it quelled the contractions for fifteen minutes before they began again. Carlson and Lewis agree that the irritating substances contained in the saliva attack the stomach nerve endings (17 p. 149). This is most likely nicotine.

Allowing that people differ, smoking does not always effect the stomach, but when it does it tends to depress secretion and retard evacuation. Since the stomach becomes more acid, more irritating, more prone to belching of acid into the esophagus (heart burn), and more inactive, there can be no feeling of hunger. The natural appetite is gone. There is no desire to eat. Logically, continued smoking excessively points toward a drop in weight.
In regard to smoking and the desire to eat, there is a loss of appetite, an increase of salivary and gastric secretions followed by a decrease, and a depression of the autonomic movements of the alimentary canal at first, followed by augmentation which acts through the vagi nerve motor reflex (27). It seems that in moderation, smoking acts as a mild laxative. Solicited opinion bears this out. Carlson agrees that it has a tendency to keep the bowels regular, but that chronic irritation by nicotine causes chronic intestinal catarrh and diarrhea (17).

Physiological appetites, whether they be a craving for sexual impulses, sleep, lazyness, or for food, involve a very sensitive arrangement. Several years ago the editor of the American Medical Association journal said:

"That American womanhood passed during the last five years through one of those periodic changes that have afflicted womankind since the world began is not a secret. Indeed women everywhere began to cultivate sylph-like figures, dieted themselves to the point of destruction; and tuberculosis rates, particularly for young girls, rose in many communities. The human appetite is a delicate mechanism and the attempt to urge that it be aborted or destroyed by regular use of tobacco is essentially vicious." (35).

Generally it is agreed that the nervous underweight woman can be helped measurably by giving up tobacco smoking. Solicited reports are that she tends to sleep better, feel better, and subjectively look better.
As diseases present themselves to the human system the reaction quite generally is to raise the pulse. By so doing the circulation is quickened, thus offering combatment to the foreign matter. A high pulse is an indication of an overworking heart. The heart has a definite working force, and beyond that great reserve. In a normal heart the reserve force is greater than in a weak heart. Through proper exercise, diet, and rest, reserve is built up. Conversely, through improper habits, such as those in which toxins are introduced into the system, the reserve is torn down. The pulse rate is a good indication of cardiac reserve force, and the lower the beat the better the reserve. It is meant by reserve that the heart muscle is in finer working order to dilate for greater exercise, and thus stronger when it is needed to pump more blood, as in fighting infections. To raise the pulse is to cause the heart to do more work.

Smoking raises the pulse beat because nicotine seems to stimulate the heart. Experiments in general have found this to be true (102 p. 17).

An increased pulse beat in a normal system would not alter the blood pressure very much, but should some section of that system be partly shut off, or constricted, the pressure would undoubtedly rise. This becomes the case with smokers. Nicotine entering the body seems to constrict the arterioles and thus raise blood pressure (49, 94, 119, 69, 73, 87).
In the recent studies at the Mayo clinic, Herrick and Cusick have found that the average increase in systolic blood pressure for a carefully selected student group of twelve individuals who were hyper-reactive to tobacco was 28 per cent, and the diastolic 34 per cent. This induced vasospasm made the peripheral skin temperature rise and the heart speed increase (49). It is interesting to note that the same subjects with unlighted cigarettes in their mouths showed no difference from normal. Dr. Harvey Kellogg makes it known that the diastolic blood pressure is always raised upon smoking (59). This pressure represents the work the heart has to do to open its valves before it can send blood into the arteries. In other words, the higher the diastolic pressure the more energy lost by the heart. Such an inefficiency of this organ is not conducive to perfect combatment of body toxins.

Heart irregularities due to tobacco are present in many heavy smokers. Many, however, do not realize this. The most common are premature heart contractions, that can be felt by the individual (36 p. 259). In this disorder heart beats are missed. It seems that the importance of findings at the last world war entry period are meaningful in connection with this irregular heart beat known as "tobacco heart." Out of the many and varied causes of draft rejections, the heart and blood vessels rated the highest, which was over 13 per cent (110). It is also significant to note here that deaths from heart diseases have increased from 159.9 per 100,000 population in 1912 to 268.1 in 1937 (11 p. 512). It ranks first in the cause of death today. There may be a relationship between the increases in heart disease mortalities and the similarly recent increases in tobacco consumption (220).
That investigators would not hesitate to recognize findings made of the rise of blood pressure, Roth and Hines took care of the problem by measuring people of high, low, and normal blood pressure. That certain people are more susceptible to the reaction of nicotine is probably quite possible, but Roth and Hines found rises in all types (87).

In dogs and cats nicotine causes a powerful vasoconstriction and rise in arterial pressure (48). In men and women this does not seem to be proportionally as great.

To finally prove that some toxic substance in the cigarette caused constriction of arterioles, Cusick and Herrill measured the amount of arteriolar changes in the vascular system of the retina. The eight arterioles in the retina were measured in microns by means of a modified graticule in an opthalmoscope (25 p. 111). Before the test the average caliber of the eight retinal arterioles in five people was 96 microns. Immediately after inhaling tobacco smoke these decreased (constricted) in size to 74.6 microns or 22 per cent. In other words the decrease in caliber of the retinal arterioles is evidence conclusive to blood pressure increase. On the other hand, a decrease in blood pressure is followed by an increase in caliber. These individuals were not oversensitive, as others might be, to temperature changes; their reaction in the retina is an excellent example of proof of vasoconstriction upon smoking. This is rather important evidence for people to heed who have the disease thromboangitis obliterans, or any other vascular disease. Certainly it would seem that this type of a person has everything to gain by giving up tobacco.
At the Department of Pharmacology at Columbia University, it was found that merely taking a deep breath will constrict the blood vessels a small amount and slightly lower the skin temperature (73). The observation that smoking of cigarettes produces a lowering of peripheral skin temperature has been confirmed by the Life Extension Institute at New York, and others (69, 94, 119, 37). Almost anyone may note that when circulation is cut off at the arm due to the way the arm is resting, the fingers become cold and numb. In a smaller way, due to nicotine in the system, constriction of the arterioles in the finger tips lowers the temperature. At Columbia University other tests were made where temperature was carefully noted and compared with room temperature; the capillary tufts at the nail fold of the finger were closely observed for length, width, number, and rate of blood flow by microscopic magnification. Yet, there was no rise in blood pressure on the inhalation of a deep breath to account for this drop in temperature and witnessed capillary constriction. Therefore, the experimentors felt that the constriction in the hand, forearm, and fingers, was not due to the cooling of the blood by the inspired air, because placing the hand in moisture had no effect. It may have been due to a reflex. It was also found, and backed by references to ten other experimental works, that inhaling tobacco smoke plays a major part in ensuing vasoconstriction. Smoke will reach the lungs whether the person inhales or not, for the lungs cannot differentiate between air with smoke in it and air without. The amount of smoke is the important item in the lungs; potential absorption is greater.
It appears that the older the subject, the less his vascular tone; and so it has been found by experiment that the blood pressure and peripheral temperature of young healthy men rise more on smoking than older people and convalescents (20 p. 669). There is probably some bodily adjustment that takes place here as one becomes hardened to smoking. To not recognize the colossal and ingenious adaptive mechanism within man to "put up" with poisons, is to cover the senses to a beauty most sumptuous.

Whether subjects are normal human beings, whether they lay down stripped for an hour, or sit reading comfortably in a chair, or whether they have thromboangiitis obliterans, there is a rise in blood pressure, rise in pulse rate, and a decrease in peripheral skin temperature. This was proved to be due to nicotine (or other active smoke products absorbed) by injecting intravenously the same theoretical quantity of nicotine into the subject (68 p. 70). There were found to be greater effects by inhaling rather than "puffing", and also for rapid smoking over slow smoking. Of course, the latter is due to much of the cigarette burning away carrying with it the nicotine. Maddock, from the Department of Surgery at the University of Michigan, reports more than eight separate studies confirming the vasoconstriction effect of smoking. He says that there is no doubt that prolonged or marked vasoconstriction for a sufficient period of time may initiate organic vascular occlusions. "The change may occur not only in peripheral arterioles, capillaries and venules, but also in peripheral arteries and veins as a result of zones of poor nutrition".
in their walls through vasoconstriction of their vaso-vasorum" (68 p. 73).

Every now and then the practicing physician has a case of acute pain around the heart. In many cases this is quite painful and rec-
curs many times in the individual. Very often this is not the true angina pectoris which results from coronary or aortic disease. This "tobacco heart" seems to be brought on by smoking, resulting in pain at most anytime with a longer duration than true angina pectoris. The latter makes itself known after physical exertion. Secession from the use of tobacco is generally effective in withdrawing the pain per-
manently (74,115,57). That smoking is associated a great deal with angina pectoris, seems the general opinion. Johnson found in his clinical study, that out of sixty fatal cases of angina pectoris 70 per cent were smokers (57 p. 665). How strong is this evidence when a high percentage of people smoke? A thousand names were taken at random from a telephone book in five different cities and it was found that over 80 per cent were smokers. White, at the Massachusetts General Hospital, believes that quite generally smoking will cause attacks and aggrivate people with true angina pectoris (115 p. 665).

Heart burn, due to acid stomachs, and heart palpitations are quite numerous among heavy smokers according to E. J. Galin of the Boston Physicians Clinical Laboratories. He mentions that when a person knows that a cigarette will quiet his nerves (even if he reads it on the back of a magazine) he becomes more nervous before smoking. More than normal nervous stimulation produces excess hydrochloric acid leading to a more acid stomach and a greater tendency toward heart burn.
Before leaving the circulatory system, it is well to consider another disease which has been mentioned only in name so far. About fifteen years ago, Leo Burger named the painful arterial disease that causes periodic and recurrent lameness, blocks the arteries, and motivates progressive gangrene leading to amputation, thromboangiitis obliterans (10). It is evident that people vary greatly in their sensitivity to irritants of most any nature. A drug may locate itself in one person in one specific organ, while in another it is located somewhere else. Whatever the norm may be, certain persons react differently. The vascular system in man seems to be the most susceptible to allergies (104). There are examples in diseases of the skin. Sultzburger, a dermatologist, believes that tobacco affects some people and not others (104 p. 11). People, he believes, who develop diseases of the vascular system such as thromboangiitis obliterans, appear most sensitive to the nicotine or some other irritant in tobacco. Getting people to give up smoking in the way of a cure is a hard task to perform. This diseased condition occurs almost exclusively in heavy smokers, and that smoking only aggravates the symptoms, is an opinion not to be slighted (7).

Mortality isn't being increased while coronary heart disease goes unchecked. The electrocardiogram is being used to note changes (65). Johnson gave health examinations along with the electrocardiogram in attempting to correlate habits with the physical examination results, as measured by electrocardiographic changes (55 p. 561). He found that there was a 50 per cent increase in the incidence of definitely
abnormal electrocardiographic changes in the smoker as compared with the non-smoker. Since the non-smokers were slightly more overweight and slightly older than the smokers, this discovery becomes even more significant.

No attempt has been made here to evaluate all of the literature on smoking and circulatory disturbances, but it seems safe to say, that as more and more experimentations are being completed, the wisdom and sagacity of heavy tobacco smoking becomes energetically challenged.
TOBACCO AND THE RESPIRATORY TRACT

Here indeed, is a large topic to embark upon. From the nostrils to the lungs is no short distance. Smoke in this tract can bathe many square inches. Consequently, the effect of tobacco ingredients over this sensitive area is of important consideration. Normally, a person breathes in about 500 cubic centimeters of air, and exposes something like 2,000 square feet of air sacks in the lungs alone (54,85). Mucous membranes line this distance like a sock fits the boot.

When the novice takes up smoking, the irritating influence of the tobacco ingredients is immediately stimulating, warning the individual of the presence of foreign or toxic matter. He then coughs, is somewhat nauseated, the eyes may water, and the head may ache. Should skeptics doubt these words, they have only to try this on their non-smoking friends, or on themselves after a short "layoff" from smoking. At first the body needs this stimulation well, but as stimuli become repeated again and again they become less noticeable and less effective. This is shown by the observation that smokers do not react as non-smokers or the novice does. It is also shown by the fact that it seems to take more smoking to produce the same satisfaction as time progresses onwards from the start of learning to smoke. At this stage the smoker may believe that he is immune to tobacco.

That continuous smoking for several years may result in chronic irritations of the throat and larynx, bring on "morning cough" and hoarseness, chronic bronchitis, and commonly result in tonsilitis and
sore tongue, is more than a physiological opinion (71). People with a
tendency toward tuberculosis would be safer if they discontinued smok-
ing. Whether there is an irritating factor in tobacco that affects the
lungs, such as silicon does in silicosis, is not yet certain. Radiol-
ological studies of over 2,000 people have not shown tobacco dust on the
lungs (66). Of course, this would not show absorbed nicotine.

Studying the action of nicotine on respiration has been done from
records of phrenic nerve potentials (40 p. 310). It has been concluded
that since phrenic nerve discharges continue for some time after the
movement of the diaphragm and thoracic muscles has ceased, the site of
respiratory paralysis by nicotine is therefore peripheral. In other
words, diminished stimulations to breathe by repeated doses of nicotine
is due to the lessened ability of the peripheral apparatus to respond to
impulses from the center, and not to depression of the center.

If women were very much like men they would not attract the op-
posite sex as they do. Whether men prefer the feminine type of a
woman is hardly a problem. As long as they are in positive health, the
more different they are from men - the more attractive they become. A
soft voice is one point in distinguishing the woman from the man. That
her smoking may or may not be graceful, will not be considered here,
but to have the voice made more harsh is another viewpoint.

In personally interviewing twenty of Boston's leading teachers of
voice, the writer found agreement among them. They ascribed 100 per cent
that smoking did not help the voice; 85 per cent consented to sore
throats, and 80 per cent to harsh voices. Among the remarks given was
that smoking produces a less vibrant quality in the voice, puts a
"fuzzy" edge on it, spoils soft voices, causes short windedness, ag-
gravates sinuses, causes bad breath, and develops in the heavy smoking
woman singer a "hard look." Of course, these opinions of voice teachers
are subjective and are based on the personal experiences of the in-
dividual teacher. Almost all of these people mentioned without any
prompting that the "smokers cough" due to throat irritation was often
present.

As usual, some people are less susceptible to smoke than to others,
and moderation does not seem to affect them. That it is a nervous
habit not conducive to a soft vibrant voice was generally agreed upon.
It seems that in drying up the mucous membranes a certain amount of
smoothness, resonance, and vibration is lost. Bergeron, of the Bergeron
School of Music cited many cases of "smokers cough" and sore throats.
One individual's voice was becoming noticeably worse; her throat was
very sore. For some time the cause could not be determined, but the
girl finally gave in to questioning by her doctor and teacher; she had
been smoking almost a package of cigarettes a day.

Women who sing, practice inhaling and exhaling vigorously as an
exercise, airing the lungs quite thoroughly. If they should smoke,
much of this would be thrown from their lungs. But, many of these
smoking singers have coughs and shortness of breath. Whether the cough
is more prevalent among men than women is unknown, but since men are
more physically active than most women, it might be expected that women
are the most affected. One woman had a voice with exceptionally poor
tone at G; at G# she had to practically scream. In a month after giving up cigarettes she had no trouble reaching C.

Morris Fishbein, the editor of Hygiea, and the Journal of the American Medical Association, points out that burning tobacco gives rise to a certain number of substances such as nicotine, pyridine, furfural, and carbon monoxide, which on large doses may damage the tissues of the human body, including the nose, throat, and linings (Personal letter).

Flinn has found that over 50 per cent of his smoking subjects stated that they suffered from irritation, burning, coughing, hoarseness, and salivation as a direct affect of smoking (37 p. 149). He also reports that a large tobacco firm, with little trouble, found one hundred subjects in one clinic with symptoms of irritation from smoking. Seventy-five per cent of this group had a congestion of the pharynx and larynx. In other words, hoarseness and dry cough, due to chronic irritation of the mucous membranes of the upper air passages, is definitely brought about in many people by smoking. Smokers who have not experienced this may have something to look forward to. Heavy smokers, with irritated sore throats, which are constantly in the healing process, cannot logically have the best of odorless breaths, anymore than an abscessed tooth would allow in the mouth.

There is some controversy over the irritating effects of tobacco treated with glycerine and that treated with di-ethylene glycol. Until studies are made by people who are in no way interested in the promotion of one or another brand of cigarette, these controversies will continue to exist. Both of these substances are used as hydrosopic agents in
the cigarette. The following chart shows a grouping of some of the investigators' opinions regarding the irritating effect of tobacco on the throat, due to either glycerine or di-ethylene glycol treated cigarettes:

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The Opinions of Eight Investigators With Glycerine and Di-Ethylene Glycol as Irritating Hydroscopic Agents.

The above chart shows that one agent is as bad as the other. Ballanger of Chicago has probably made the most thorough study of throat irritations (4). With the assistance of ten well known otolaryngologists, he conducted a smoking experiment on a total of 224 subjects. After careful objective examinations, he concluded that glycerine and di-ethylene glycol treated tobaccos made no significant difference in the irritations of the mucosa. In fact, cigarettes with no hydroscopic agent showed the same results. This would seem to indicate that it was the intense heat of certain cigarettes that caused the irritations, and not the hydroscopic agent. It also seems to Ballanger that the lungs and bronchial mucosa secrete mucous especially in the morning, to remove
the non-absorbable substance in the inspired smoke. This somewhat chokes the breathing, and "smoker's cough" develops.

It is interesting to consider the controlled experiments conducted at the Ayer Foundation in Philadelphia (63). Here it was found that women who smoke tend to enjoy foods which are tart in preference to those which are sweet. This may be due to the more rapid aging of the taste buds in the tongues of women smokers as they grow older. This is just another example of the reaction of the respiratory tract to constant irritation.
NICOTINE EFFECT ON THE LIVER, KIDNEYS, AND INTESTINES

With tea, coffee, and alcohol, people are found remarking about the beneficial results, but there is no pretense that tobacco is a food or that it is beneficial to health. From the athletic trainer to the voice specialist it is forbidden. In fact, advertisers of tobacco admit its harmfulness when their brand is advertised to be not as harmful as some other brand. Tobacco is not craved for; liking it is learned by forcing the system to adjust to it. This is easily noted by the feelings of nausea in the stomach, and dizziness. If a cigar was eaten, death would result, therefore the only difference between smoking it and eating it, is the degree of nicotine entering the body (61).

While nicotine enters the blood through the linings of the mouth and lungs, the kidneys work to excrete it with the urine. To be sure, very little nicotine is absorbed into the blood stream even when a person inhales, but the amount of nicotine excreted in the urine of persons who smoke, varies from 1.4 to 9.8 milligrams every twenty-four hours and tends to increase with the number of cigarettes smoked (21 p. 90). Very little nicotine gets into the body, and it seems that very little is needed to cause bodily disturbance. It is possible that some nicotine may be destroyed in the body so that the nicotine in the urine may be only a fraction of that absorbed. Kirk believes that only 10 per cent of the nicotine absorbed gets to the urine (60 p. 191). There may be some truth in this, according to findings at the famed Mayo Foundation.
Here it has been discovered that the ability of the liver to destroy toxic drugs is many times greater than an equal mass of skeletal muscle (8). Whether it is destroyed or inactivated was not determined.

Helmer has isolated nicotine in crystalline form as oxalate or picrate from the urine of humans who smoked tobacco. Extracts of blood which appear to contain nicotine also have been prepared (43). If tobacco smoking is stopped for two or three days the nicotine disappears.

The effects of nicotine on the excretory system seems to be to overbuden it. Besides increasing urination, sugar has been found in the urine (65 p. 4). Bodily habits seem to be affected. In 30 per cent of Ivys' subjects, smoking was necessary in order to defecate or to have complete bowel movement (39 p. 900). A New Jersey doctor, writing to the editor of the American Medical Association Journal, tells of a woman who became constipated when advised to give up smoking (personal letter). Of course this habit was built up by repetition of smoking and then defecating, therefore becoming merely a conditioned reflex. This might have worked the same way in another smoker by drinking a glass of water before preparing to evacuate the colon. The writer mentions this situation purposely to emphasize the importance of conditioned reflexes.
THE ULCER, CANCER, SKIN, AND TEETH

It may seem to the reader that smoking is being made unduly hurtful—that its good effects are not being stressed. The truth of the matter is that beneficial effects are absent (or as yet have not been reported). To state that tobacco is on a level with alcoholic beverages will probably be like putting ones chin out in the face of the opposition. Tobacco, however, seems to be connected with gastrointestinal ulcers. As noted in the respiratory tract discussion (page 17), smoking causes hyperacidity in the stomach, and the excess acid remains in there longer than it normally would. This increased gastric secretion, which may be due to some irritant in the stomach or nerve arrangement there, tends to cause chronic intestinal catarrh, increased intestinal movements, and duodenal ulcers (71 p. 32).

In examining 300 patients, Gray found 51 with symptoms of duodenal ulcers. When these patients stopped smoking these symptoms disappeared, but they regularly reappeared within one week when the patient again started smoking (49a). Since smoking constricts blood vessels, and there are many in the stomach, the wall may get an inadequate supply of blood, thus allowing the stomach lining to break down giving ulcers a chance to get started (85a).

From over 2,000 medical records, Johnson and Shot determined to find out the effect of tobacco on health (95 p. 586). They found over 30 per cent of the smokers had throat and nose irritations, coughs, and frequent colds, as compared to less than 15 per cent in non-smokers.
The most important item, however, was that as smokers grew older, stomach acidity in the form of "heartburn" increased exactly 100 per cent. To have the stomach almost constantly in such an acid condition would logically infer that stomach and intestinal ulcers were being invited. Individuals are not the same. Some cannot smoke very much during the day because their heart beats so fast at night they cannot sleep; others become dizzy if they smoke on an empty stomach; still another cannot smoke when she drinks, for when she does she faints. Despite individual differences, learning to live well is the best guarantee of being well.

Before tobacco smoke ever reaches the stomach it covers a good deal of surface. From its source between the lips, it bathes the mouth and teeth. Aside from a beauty point of view, the contributing cause of mouth cancer is split between ragged dirty teeth, and tobacco smoking. This is the opinion of a man who spent a great deal of his life working with cancer (9a).

It is the opinion of workers on the cancer problem that prolonged irritation becoming chronic is one of the biggest causes of cancer, according to Dr. H. L. Lombard of the Massachusetts Department of Public Health (lecture delivered at Boston University in 1938). This statement alone, would place smoking under suspicion. The duration of an irritation plus something else seems to give cancer. Some think that this something is hereditary, while others believe that it is tied up with body metabolism. All agree, however, that if irritations can be avoided, cancer will be prevented. Dr. Lombard has mentioned the cases of pipe smokers receiving low degree burns over and over again from the heat of the smoke, eventually developing cancer of the lip. He says
that if cancer is inherited, as some people believe, a low form of cancer in the mouth of a mother might appear in the liver of her future child. This is because a lip cancer in the mouth remains a lip cell, and even though it is in the liver of the daughter it is still a lip cell. This infers strongly that a girl who continues to smoke heavily is raising the potential, not only of herself to cancer, but of her un-conceived children.

Cancer can be cured, and if irritants are removed from skin tissues, it seems a step has been made toward prevention. The late Dr. Bloodgood of Johns Hopkins, believed that women could control much of the spread of cancer. He says, that "the modern woman is teaching man how to smoke with the least risk of cancer because she keeps her teeth clean and smooth." Dr. George Stewart, associate of Bloodgood, reports a recent survey of 39 cases of cancer of the oral cavity in women. Out of this number only six definitely did not use tobacco (personal letter). He believes that this is a small percentage of cases in women because they are much more careful in their habits of taking care of their teeth than men. It is, therefore, much more prevalent among men. Stewart says that it is difficult for him to understand why so many women smoke, because they all spend a great deal of time and care on personal hygiene, and are particularly interested in their looks.

Smokers, as a rule, fail to notice any deleterious effects from the practice. This is not always the case, since many smokers have cited personal experiences to the writer. According to Bogan "the established clinical observation that cancer of the mouth are unduly prevalent among
heavy tobacco users is by no means controverted by the rarity of skin
cancers in mice treated with purified tarry substances obtained from
the combustion or distillation of tobacco." (9b).

The tar content in tobacco, coming from the vein of the tobacco
leaf, may be responsible for the irritation set up in the lungs. In
this way constant use of tobacco may create in man a disposition to
cancer at the place of provocation. The time needed to create this
disposition likely varies with individuals. Muller suggests that
members of families disposed to cancer, and persons with chronic
catarrhs of the respiratory tract, should be dissuaded from smoking
(75 p. 1372).

Without going much further in this discussion, it can be said with
certainty that tar is a highly complex mixture that contains a carcino-
genic agent that has not been isolated (92). A great deal of work has
been devoted to this tar since it is so concerned with cancer. Whether
it is the tar or the effect of the hot irritating smoke that is the
cause, has not fully been decided. The tar bears importance.

Dr. A. S. Gibson, a plastic surgeon and dermatologist in Boston,
suggests and believes that the pyrodine (tar) in cigarettes acts on
the sex glands and ductless glands, prematurely aging the person so that
the facial skin shows wrinkles around the eyes and lips (personal state-
ment). This opinion, however subjective, would not have been offered
had it not been worthy of consideration, especially to young women.
Gibson is not alone in believing that the complexion may be ruined
(see page 51). The effects of smoking on beauty are difficult to
determine, since many beauties smoke without appearing to lose renown. Bogan cites that peripheral vasoconstriction with consequent pallor of the skin is now often covered with pigments (personal letter).

Stained fingers, discolored teeth, bad breath, and physiological disturbances suggest that excess emphasis must be placed on the care of women's personal appearance, if her beauty is to go unimpaired. It surely cannot be improved upon or even maintained at par, if she smokes. Cigarette stains do not effect the enamel or dentine of teeth, and may be removed, but it takes a very smart woman to remain attractive and continue to smoke heavily. Smoking more than four or five cigarettes a day seems generally to be considered heavy smoking (102 p. 37).
NICOTINE AND THE NERVOUS SYSTEM

The beginning of all motion by the ordering of the motors to react, what to do, and the will to accomplish this action, is the work of the most complex and intricately functioning portion of the human body - the nervous system.

To allow nicotine to touch the nerve endings tends to affect the receptive mechanism of the ganglion cells, thus effecting the contractibility of the muscles. Solomon says that this effect paralyzes the muscle (98 p. 390). It seems that nicotine paralyzes the inhibiting vagus trunk so that the heart rate is increased. Nausea and violent diarrhea (with heavy doses) frequently occurs. Both oculomotor and sympathetic fibers to the pupils may be affected by nicotine (98, 65, 39). Since the vagus tends to be slowed by nicotine paralysis in its inhibiting effect, the salivary glands secrete more saliva. Solomon also finds that nicotine applied directly to muscle cells will diminish their excitability and irritability. The nicotine in the smoke would not be so severe as this, but he found that nicotine was absorbed rapidly from the mucous membranes and lung surfaces.

A study was made of 45 men and 14 women who extracted nicotine and nicotine sulphate from tobacco leaves. Some of these people manifested irritations of the parasympathetic system, such as brachycardia, hyperacidity, spasm of smooth muscles, excessive salivation, and sweating. Others showed disturbances in the sympathetic nervous system such as tremors. Sleep disturbances, loss of memory, and neurotic
manifestations are caused by direct toxic action of the nicotine on the central nervous system (39 p. 550). Pupillary responses likewise have been noticed with a slowness of the reaction of the pupils (54).

Professor C. E. Turner, of Massachusetts Institute of Technology says that, "prolonged use of tobacco tends to produce chronic inflammation of nerve tissues. Among the more common symptoms are headaches, vertigo, and insomnia (11 p. 309.) It seems quite common to the writer to hear of heavy smokers, especially women, who have trouble in getting to sleep nights. Cigarettes are more injurious because they are not so irritating as other forms of smoke, and are therefore inhaled with much greater chance for absorption. This irritation resulting from excessive smoking need not be so small in women, for she is more sensitive due to her higher nervous irritability (Burton-Opitz, personal letter).

Physicians have testified that it is more difficult to break a woman from smoking excessively than a man. Her nervous system seems to be more greatly affected by nicotine (36 p. 258). As a rule, the young woman does less in the way of physical activity during the day than the young man. She has more time to smoke, and does. It might be expected, therefore, that not being so fatigued at night, smoking more cigarettes, and possessing a more highly sensitive nervous system, the young woman's possibility of having a touch of insomnia is somewhat enlarged.

After reviewing the literature of a dozen experimentors, Franke concluded in his study with frogs and dogs, that a spinal reflex could
be obtained greater at first by nicotine injection, but was depressed slightly later on. To him it seemed that the sight of loss of irritability in the spinal reflexes involving skeletal muscles, was mostly peripheral and not central (38).

That the rate of contraction of the heart is balanced and controlled by the opposing divisions of the autonomic nervous system is established (54a p. 140). The parasympathetic nerves will slow and weaken the heart action, and are normally balanced to oppose the sympathetic nerves, which when stimulated quicken and strengthen the heart action. It is through their influence on the autonomic system that certain drugs produce their effects on the body. There is a tendency for nicotine, therefore, to affect the parasympathetic division. In the stomach it probably deadens the parasympathetic nerve endings allowing somewhat "free rein" to the sympathetic to decrease gastro-intestinal contractions. Likewise, the nerves weakening the heart action are impaired so that the opposing set increases the heart beat.

The autonomic system includes efferent ganglia along the vertebral column and walls of the viscera. It is concerned chiefly with the metabolism of the heart, lungs, involuntary muscles, glands, and thus is related to emotions. It can not be decidedly separated from the central nervous system, which controls all acts of consciousness, for part of it originates there. The cranial and sacral divisions (parasympathetic) control inhibiting action, while the thoracolumbar division (sympathetic) controls increase in action. To trace autonomic pathways to blood vessels and organs, nicotine has been used (64). The neuron from the
central nervous system enters the autonomic system (either the cranial, thoracolumbar, or spinal nerves) where its axon surrounds a cell (autonomic ganglion with synapse). From this cell, the neuron (post-ganglionic) leads to the viscera where action takes place. The nicotine substance is painted on an exposed preganglionic fiber with no action taking place at the synapse, and thus no action on the postganglionic fibers to cause action in the viscera. By stimulation of the postganglionic nerve, the proper action takes place in the viscera. This experiment readily shows that the synaptic connection between the preganglionic and postganglionic neurons is paralyzed by the action of nicotine (12 p. 164).

Diagram of Autonomic Pathway to End Plate Action

There is also very little protection for the postganglionic fibers since their only covering is a thin fatty sheath. It would seem, therefore, that nicotine absorbed through the lungs, contacting any preganglionic (or postganglionic) nerve, would tend to slow down the expected reaction that that particular fiber was responsible for.
Starling emphasizes that "the first effect of the drug is a powerful stimulation of the ganglionic cells, so that if the drug be injected, there is an enormous rise of blood pressure, owing to the universal vasoconstriction that is produced. The stimulation gives place to a condition of paralysis; the blood pressure falls below normal, owing to the cutting off of the peripheral vascular nerves from the vasomotor center. Stimulation of the preganglionic fibers is now without effect, although the normal results follow stimulation of post-ganglionic non-medullated fibres." (100 p. 799).

A great deal of the habit of smoking is probably to have something to do. Of course, the person who has not learned to smoke will find something else to do. At Wellesley College most girls smoke because their friends do and they are curious. They admitted disliking it at first, but later they learned that they were harder to give up. Over 63 per cent smoke from one to ten cigarettes daily. About 50 per cent smoke from one to ten cigarettes daily. About 50 per cent of the girls believe that it soothes their nerves, but does not give them a "lift". If the effect of nicotine is to dull the nerves, naturally the soothing effect will be felt with lack of elevation. The largest per cent of the smokers do not consider it a social asset, but the majority of girls would feel quite out of place if they did not do as everyone else does (13 p. 25). This well illustrates that humans are still gregarious animals. If people insist on practicing ill-health habits, moderation must be the watchword. It will take a superior type of a girl to control herself to four or five smokes a day, than it would to use an
indifferent, "don't care" attitude, and allow the cigarette to "run away with her."

Dr. Hugh S. Cummings, former surgeon-general of the United States Public Health Service and at present the director of the Pan-American Sanitary Bureau at Washington, believes that the cigarette habit among women tends to cause nervousness and insomnia (personal letter). He believes that the woman's nervous system is more highly organized and more sensitive than the man's nervous system, and thus she reacts more to nicotine. In a letter to the writer, Dr. Cummings goes further by giving the following statement:

"It seems to me that the old Greek motto, 'Moderation in all things' applies in the case of tobacco as in almost every other pleasure. The question of what is moderation must always be an individual one, and there is no doubt, I think, in the minds of many competent physicians that the excessive use of tobacco is harmful, and perhaps more harmful to women than to men."
To the reader who doubts the many possible effects of tobacco smoking, the introduction of vision and hearing into this discussion will probably bring on a feeling that the author is making a big issue out of a small thing. But, while health is the immediate concern, consideration must be given to the organs that are probably receiving about 93 per cent of sensory impressions.

It seems that nicotine in low concentration stimulates the cells of the autonomic ganglia, but in high concentration paralyzes them (80 p. 185). Where delicate control is needed, that is, in the finer muscles, motor disturbances (which are due to nerve disturbances) result in reduced skill in these muscles. These disturbances in small muscle control may extend to the tiny muscles of the eye and interfere with sight (11 p. 309). If nicotine attacks the nervous system, it would seem logical to expect corresponding disturbances in the muscles of the organs, especially the more delicate ones.

Experimentors differ in their opinions according to their individual experiences. Whether toxic amblyopia is caused by vasospasm of the eye blood vessels or by a nerve connection, is often discussed. Drugs that vasodilate have aided in treatment, and the obtained results with these drugs (such as silver nitrate) seems to further substantiate the argument that tobacco is a vasoconstrictor, affecting the eye blood vessels (22). There is probably truth in both. It is interesting to note what Dr. J. A. Gunn, Professor of Pharmacology at the University
of Oxford, has to say (109 p. 370). He believes, that since amblyopia may be caused by quinine, optochin, nicotine, idoform, methyl alcohol, atoxel, and others, which are typically nerve poisons other than vascular ones, the toxic amblyopia is on the nervous side and that circulatory changes come secondary. Since ear derangements are often present at the same time, he believes affected nerves are more likely to be the problem than any circulatory changes.

According to Johnson, amblyopia refers to an optic nerve degeneration with the pupil of the eye affected so that sometimes vision is 20/100 and red and green are reduced in the vision (56 p. 60). He has found that thiamin chloride contains the vitamin B₁, found in Brewers yeast, which is helpful in improving abnormal vision caused by excessive use of alcohol and tobacco. Of course, the term toxic amblyopia means, literally, partial blindness due to toxins, but is generally used in a restricted sense as referring to loss of vision due to absorption of some external poison. The nerve fibers or the ganglion cells of the subchiasmal portion of the visual pathway seem to be the most susceptible to poisons. According to Traquair, both eyes are affected (109 p. 351).

In the British Isles, Traquair has definitely noticed that the patient is usually a man about middle age who states that his sight has been failing for weeks or months. In Edinburgh, where studies of this type have been carried on for years, it was noted that pipe smoking was the popular cause, unless a large number of cigarettes had been used. Traquair says that medical studies show the disease tends to appear
when physical health is beginning to decline; or when it is preceded by some illness. According to Griffith of the University of California physics department, this disease is more severe in young people and is on the increase (42).

Homewood has shown in near to far tests and far to near tests of visual accommodation that nicotine acts as a stimulant and then as a depressant upon the nervous system (52). She has verified the previous work done by Couch, Schutz, Newbury, Rinaldo, Houston, and Stevenson from 1931 to 1937 at Wellesley College (30). These people have found that rest throughout the tests makes for better performance, but that smoking also allows for better performance. The difference, however, is that smoking is weaker than rest, and finally becomes a depressant, whereas rest eventually reconditions the person (23). This has been an important study the last few years at Wellesley, and may be summed up by quoting from the Wellesley College Studies as follows (30 p. 101):

"From the whole series of experiments (1931 - 1937) it can be concluded that smoking first stimulates and then depresses the function of visual accommodation, and that the effects of rest and smoking upon visual acuity, accommodation time, recognition time, and enunciation time can be reliably and objectively measured."

The above statement seems to illustrate that smoking while studying would be of a definite disadvantage. At the Oxford Ophthalmological Congress meeting in England, all those entering into the discussion agreed that giving up tobacco brought on improved eyesight from tobacco amblyopia. The reason there is so little amblyopia though there is
much smoking, was explained by many smokers being in fair health (109 p. 358). This indicates that when the body is less resistant to poisons due to ill health or fatigue, tobacco should be abandoned.

Toxic deafness frequently accompanies toxic amblyopia associated with the use of tobacco and alcohol. This has been verified at the Massachusetts Eye and Ear Infirmory where it is acknowledged that tobacco and alcohol cause vision impairment (19). At this institution it is known that the ganglion cells of the retina become affected upon smoking, and because the spinal ganglion cells of the cochlea are similar, they too may be affected. Diagnosis of this is justified when smoking is given up and vision improved, often times returning to normal.

From the evidence offered above, it is with all probability that the immoderate and unchecked use of tobacco cannot in any manner help eyesight and hearing; it can only hinder it.
SMOKING AND MENTAL EFFICIENCY

To carefully cover the wide variety of evidence offered by scientists and educators on the relationship of tobacco smoking to scholarship, would be to take more time than is possible in this discussion of smoking. But, on the other hand, not to mention this topic would be to neglect existing truths.

The report that tobacco is not used at West Point Military Academy (where physical and mental condition is near perfection), and the information that studies made at Columbia University and Antioch College show smokers to have lower grades and more advancement difficulties, is made by Moon (73 p. 652). There is also the exhaustive study made by O'Shea reporting, that out of over twenty studies of scholarship in high schools and colleges made by educators throughout the United States, all show the non-smoker to be superior to the smoker. In all laboratory tests involving accuracy, memory and performance, the non-smoker appeared better than the smoker. These were simple intellectual process tests that could be accurately measured and were essential to mental efficiency (91 p. 185).

Although 70 per cent of over a thousand girls at Wellesley College in 1931 felt that smoking did not effect their mental work, and 74 per cent in 1937, the non-smokers rated higher in scholarship than the smokers by 1.6 to 1.4 respectively on the basis of 3 as perfect (120).

Mendenhall reports studies made at a dozen colleges institutions where it has been shown definitely that non-smokers were superior
average grades to smokers (71). Of course, there is a criticism here, in that it is not known how these smokers made out in later life activities. Since tests of intelligence were not given, it might be that they fared as well as the non-smokers. These differences in scholarship are hard to explain according to the writings of Barp in 1926.

The experiments performed by Mendenhall in 1930 throw more light on this mystery. This laboratory physiologist says that nearly all habit producing drugs (which affect the central nervous system) are depressants to the brain. To tell whether one is depressed, there must be some way to measure the sensitivity of the brain to special drugs, which in this case would be nicotine. This, Mendenhall has accomplished (71 p. 50). By measuring the amount of electrical stimulation or shock which a subject can feel, he can be classified to high or low sensitivity. Small shocks, which are at first undetectable, but gradually increase till they are just detectable, were used. For instance, if it took only fifty stimulations for a person to note the shock, that person would have a high brain sensitivity, because that person's brain could detect slight disturbances to the body. If, on the other hand, it took two hundred stimulations to detect a shock, the brain would be low in sensitivity, for it would allow greater bodily disturbances without awareness to them. Mendenhall found, that out of 750 observations of this type, before and after smoking, there were only about 28 per cent that had brain stimulation, while 72 per cent had brain depression. This indicates that smoking, as a rule, does not clear or stimulate the brain; in fact, it depresses it. Rest stimulates the brain, as shown by holding
false cigarettes in the mouth during these tests, which indicates that nicotine is the probable element that affects the central nervous system. The fact that rest is stimulating, infers that during the interval, fatigue products are somewhat removed from the brain, while in the case of smoking, fatigue products are not eliminated. In any case, a clear brain is more receptive to stimulation, and therefore responds quicker and is more conducive to mental efficiency. It would seem that smoking while studying is far from being the right thing to do.

As already mentioned in this dissertation (p. 38), the ability to see properly, and to recognize and enunciate the recognized object, is lessened by smoking. In other words, the man or woman student studying for an examination, who is in need of a clear brain to concentrate, and wishes to gain the most from the time spent in studying, should get along with as few cigarettes as possible. Of course, not to smoke at all during the study period would be more ideal. But, this takes will power which some smokers lack. Because they fail personally to notice any difference between smoking and not smoking, many smokers will ignore the truths of scientific research. For this type of person, with the habit so well rooted, there is little hope. He will probably be unwilling to accept any type of proof.

The logical argument will appeal to many people. In college, physical condition for successful performance in athletics is stressed. Cigarettes are eliminated from the training because they cut down the maximum of success in the endeavor. Schools also build knowledge for future application - making a living and living a happy life. Yet, in
after-college life, training is given up. It would seem that the desire for maximum success now, is of less concern than the earlier college activities. It takes fine muscles to act and think in a busy universe. All muscles fatigue similarly, whether in college or out of college, whether in direct physical exercise or indirect activity, such as thinking and acting on various problems. It seems logical, therefore, that better performance in college life through endurance to physical strain is comparable to better performance in later life through endurance to mental and physical strain. Surely perfection is not confined only to the athletic field; all the great accomplishments in the world are above that. More briefly, if cigarettes lower endurance to greater activity in sports, they might likewise do the same with mental efficiency.
THE EFFECT OF TOBACCO ON REPRODUCTION AND MOTHERHOOD

It is quite probable that there are few subjects of such vital concern as the one about to be embarked upon. Whether women aim for "careers" in life or work for a home, makes little difference to their fundamental earthly purpose. They have the accountability of the future civilization in their own hands. Reproduction and motherhood requires sound physical condition and sound judgment, if the offspring is to be near perfection (normal). Surely, there can be no greater responsibility.

Cigarette consumption in the last twenty-five years has increased more than 1700 per cent due to the rise of women smokers (Fishbein, personal letter). It would seem, that of the many possible ailments due to smoking, women are more susceptible now than ever before. In planning the hygiene of her daily life she might well consider the smoking habit. Since smoking has increased among women to such an extent, it becomes a matter of interest and real concern, especially as it affects motherhood.

Smoking is not new to women in many nations where certain classes smoke pipes and cigars (33). Many in the southern United States use snuff which is another form of tobacco. From about the time of the last world war, women in general have increased their number of smokers. It is of interest to note the corresponding increase over the same period of years in diseases of the heart, lungs, kidneys, and the 58 per cent increase in cancer from 1912 to 1937. But, by far the most
important item is the fall of the birth rate over this same period.
From 1921 to 1938 almost 100 per cent of the countries of the world have shown a decrease in the number of children born. The United States birth rate ranks lower than most of the civilized countries today. It seems that the more prominent the country, the lower its birth rate. Out of 67 countries, big and small, reported in the League of Nations Yearbook, 15 had birth rates of under 18 per 1000 population. Countries such as England, France, Germany, and the United States are included on this list, with Finland, Italy, and Russia only slightly higher (118 p. 512). All have been declining.

Are people controlling birth in the civilized nations? Does the nervous strain in daily life effect this fall? Is high intoxication of the body due to over indulgence in toxicus substances, a possible cause? These questions are hard to answer, but, no doubt there is truth in all of them. To eliminate a part of these truths would logically lead to some change in the birth rate. Hitler and Mussolini have been advocating large families, but still they witness a birth rate drop. Education does not seem to help, for as people become more learned they have less children. Since the year 1923 the United States alone, has seen a birth rate drop of 19.4 per cent (1938). To change our present nervous tension with the feelings of insecurity, is almost without hope. Why be concerned with the fall of the birth rate? The rate does not fall unless the economic situation of a nation, and the fertility situation are contributing factors. A lack of fertility is caused by some unknown that bears investigation and discussion. More than one civilization has fallen due to a steadily declining birth rate (99).
Dr. Donald Macomber, addressing a group at Harvard Medical School has said, "...As we know, since the decline and fall of the Roman Empire the first symptom of decay is a diminishing birth rate and rising sterility....Sterility is never found among strong, virile pioneer people."

Almost 50 per cent of college women do not marry, and since more are going to college now, fewer children might be expected. Also, the birth rate is higher among feeble-minded people than the more intelligent ones, which tends to propagate the inferior elements of the race, while the more superior elements are found in the people who are more sterile (96 p. 335). Macomber further points out that one out of every six couples in the United States today, are sterile. The weight of this statement seems unbelievable. This makes the sterility factor unquestionably important.

That women may be more feminine is in accordance with nature. Sterility in many forms of female animal life tends to give rise to male characteristics. This is somewhat evident in human beings. If excessive tobacco smoking causes any tendency toward lack of fertility in the ovaries, it is not a desired condition. Carrel, the Nobel Prize winner of 1912, and author of one of the most outstanding books in this era, enthusiastically states: "A great race must propagate its best elements. However, in the most civilized nations reproduction is decreasing and yield inferior products. Women voluntarily deteriorate through alcohol and tobacco....The women belonging to the oldest stock, whose children would, in all probability, be of good quality, and who are in a position to bring them up intelligently, are almost sterile."
(19 p. 219). It now becomes evident that the study of tobacco and nicotine on the human female system is justified and in order.

The rate of the heart beat was studied in the child before it was born to determine whether smoking by the mother in any way affected the babies. The average rate of the heartbeat of the experimental unborn babies before the mother smoked was 144. After eight to twelve minutes of smoking, the average rate jumped to 149 (Fishbein, personal letter). Although this is true, its significance may mean very little, for the normal fetal beat may range anywhere from 120 to 160 per minute, with an average of about 140 (Meaker, personal statement). So, prejudiced findings must be weeded out of this discussion if anything constructive is to be suggested.

In 1930, Mendenhall, of the Boston University Medical School, felt that the interest manifested in pregnant women smoking was justified, but it was too soon to determine definitely its effects. He tells of a paper presented before the American Association for Medico-Physical Research in which it was stated that: "A baby born of a cigarette smoking mother is sick. It is poisoned and may die within two weeks of birth. The post-mortem shows degeneration of the liver, heart, and other organs. Sixty per cent of all babies born of mothers who are habitual smokers die before they are two years old." (71 p. 51). This has also been reported by Kress, former neurologist of the Washington State Sanitarium (Kress, personal letter). It has been questioned by the American Medical Association in the light of a study made in 1927 by Schrimp-Pierron. This professor reviewed medical literature consisting
of a bibliography of seventy pages with no mention of tobacco heart in
new born children (90). This, however, was thirteen years ago.

Almost every physiological action in the human system has been
demonstrated first in animals. Rats, mice, dogs, rabbits, and guinea
pigs, have been used very successfully in determining the effects of
foods and poisons on physiologic processes. Several experimentors with
rats have noticed that the estrus cycle (period of sexual excitement or
heat in female) has definitely been altered in nicotine containing
diets (107, 6, 116). In 22 male rats, out of 69 examined over a twenty
month period (following a .05 - 2.0 mg. nicotine injection) there were
advanced atrophy changes in testicles (1).

Sajous, a Frenchman, and Greenhill, another experimentor, feel that
nicotine can produce direct effects upon sex organs and can produce
disastrous results in females and their offspring (83, 41). This is
substantiated by Ngalobelli, who has noted that women employees in
tobacco factories show a marked decrease in the number of pregnancies,
more miscarriages, and infant death (72).

Not all women smoke to excess; many have the mental and physical
power to smoke only a few a week for their enjoyment, but this is pro-
bably the truth in a minority of instances. A cigarette habit, once
begun, demands some ability, and constant thought on the part of the
person to keep it to a certain level. Without giving smoking a thought
one way or the other, the tendency is to increase. For a woman to in-
crease her cigarette consumption is to endanger the early growth of a
delicate baby (24).
Among college graduates in America the percentage of sterility is from 25 to 30 per cent. Taylor believes that this is due to a lack of a properly balanced diet (105). Smoking quells the appetite, and the diet is neglected (see section on Anemia and Body Weight p. 7). There seems to be a connection. Taylor believes that diets lacking in protein, and certain mineral salts, such as calcium, produce a lower fertility rate. It is known that vitamin E is necessary for reproduction. The United States Department of Agriculture says that the lack of vitamin E shows evidence for repeated abortions in women, that have been followed by normal pregnancies after the administration of the vitamin, in the form of wheat-germ oil (118 p. 118). Thus, with the appetite impaired, lack of proper food reaching the stomach, and semi-starvation the result, the normal estrus cycle is disturbed (116).

In the case of two vitamins, A and E, there is evidence that deficiencies do interfere with reproduction. The 1939 Yearbook of Agriculture gives the following information: "A minor deficiency of vitamin A quickly affects the soft membranes in the reproductive organs of the female rat. The heat cycle, the formation of ova, and the early development of the fetus is not affected. But difficulties appear about the middle of pregnancy resulting in hemorrhage or abortion; or birth is delayed, labor is usually long, many of the young are stillborn, and many of the mothers die in labor. Severe deficiencies effect the testes of the male. Both the male and the female can be cured by doses of vitamin A." Much has been done in endocrinology the last few years. Sixty per cent of cases of primary sterility (congenital or acquired) show endocrine gland disturbances (106). The Yearbook of Agriculture
states that, "...the pituitary secretions are themselves protein, and it is altogether possible that adequate dietary protein is essential for the formation of the pituitary hormones. Such a situation might explain the dramatic effect on growth, reproduction, and lactation of increasing or decreasing the dietary protein." (112 p. 693).

Since fertility tends to diminish gradually after the age of 33 in men and 26 in women, it is possible that this is cause of college people failing to have many children. They tend to marry late in life. Despite other reasons for a declining birth rate, it is well to note that Charles Darwin has said that any change in life habits tends to affect the reproductive powers. Thus, habits become important. In the production of eggs and spermatozoa, maximum fertility is desired. Few, of the Canadia Medical Association, says "...the sex cells are highly specialized cells, and are among the first cells in the body to suffer from constitutional disturbances." (106 p. 116). One of the large groups of constitutional disturbances, and there are many, is chronic intoxication. Few mentions that the excessive use of tobacco or alcohol may act as underlying factors. Logically, it would seem that the more complex civilization becomes, the more likely habits will affect sterility. If smoking tends to depress one in the face of the tension of civilization, and is, therefore, desired by those who regularly smoke, yet remains underlying for constitutional troubles, the birth rate can hardly be expected to increase. It can only continue down.

Hofstatter of Vienna, suggests that many of his elderly people preach in times of poverty the indulgence in smoking tobacco, because they believe that it lowers the fertility and thus reduces the chances
for birth. He also has shown the sex functions of the ovaries to be lessened (50). Unbehaun, another European, after animal experimentation, believes that degeneration of the ripening follicles occurs due to nicotine (111). The Japanese experimenter, Nakasawa, observed in female rats that atrophy of ovaries, uterus, and fallopian tubes resulted with continuation of nicotine injection, finally producing sterility because the menstrual cycle was stopped. Rats injected during pregnancy gave birth to young which were weak and died early (79). Still another research worker, Sodano, claims that nicotine does not act directly on the ovaries, but that it tends toward hyperthyroidism which disturbs the function of abdominal organs, such as the uterus and ovaries. The milk lactation of these individuals affected the offspring. He finds that eventually sterility may be due to inflammatory catarrhal processes in the uterus and tubes, determined by prolonged administration of the poison (97). Further evidence that nicotine affects the female reproduction system is offered by Romaniello, and by Schuster-Woldan (86, 91).

It is noted that as women become aged they add many wrinkles to their face, due to the withering of their ovaries. If excessive smoking tends in any small way to affect the young woman's sex organs, causing partial sterility, it would seem that signs of wrinkles on her face would be in order. Alcohol might do this also, but few drinkers of alcohol are non-smokers. Kress reports this premature aging by citing the words of a director of the National Beauty Shop Owners' Association, who has said:

"The features of women who smoke grow sharper as the nicotine habit fastens on them, the skin becomes taut and sallow, the lips lose their
to the point of having healthy children was their speciality in which they were professed. An analysis of their replies showed:

84% answered the question — Yes
6% " " " — I do not know
3% " " " — No
3% " " " — Only in case of individual susceptibility
4% " " " — No definite opinion

The above speaks for itself. A great many of these men in replying, wrote a large variety of accounts of their experiences with tobacco smoking mothers. They reported results of nervousness, milk poisoning, underweight babies, and general lack of good health habits, so essential to maternal health. Some believed that four or five cigarettes a day might cause little harm.

A physician vitally interested in maternal health looks forward to having his expectant mothers produce perfectly normal children at proper intervals and under such other favorable conditions as will result in an amelioration of their physical and mental condition. According to Campbell, obstetric patients in the last twenty-five years have increased in their smoking about 50 per cent. By clinical observation he became convinced that smoking in many maternity cases was absolutely detrimental to the health. Is not the maternal organism already overworked by physiologic demands of pregnancy without absorbing nicotine? His results have shown that women who smoke, often have serious menstrual disorders, and have more than the usual number of cases of diseased sex organs. People who work in tobacco factories have more spontaneous
abortion, and more deaths among their children between the ages of one and three (14 p. 146).

The young woman who wishes to prepare for abundant fertility should absorb some of the above information. Health educators and teachers of science have the opportunity to present these facts to their classes, that all young women may profit. In most cases the girl who smokes heavily is quite unaware that she is not helping herself. Preparing herself with information will allow her to take steps to insure herself for normal healthy children, and realize that the crown of womanhood is motherhood.
LONGIVITY

Life expectancy has been increased due to the teachings of science and medicine. How can smokers expect to continually poison themselves and live to see old age? The body has such a fine adaptive mechanism that some heavy smokers will survive, but an organ which is submitted to over-activity, toxic influences, and abnormal stimulations, wears out more quickly than the others. This premature senility brings on death to the organism (18 p. 79). To prolong age is not desirable, but the aim should be to extend the era of youth, which can be done, so it seems, only by the conservation of organic activity. Does smoking conserve organic activities and promote longevity? This question can only be answered by studies over a long period of time.

In 1918, Charles Emerson was secretary to the Dartmouth class celebrating its fiftieth anniversary. He found that of the class members who had used tobacco in college, the average age at death was 49 years, 9 months, and the non-smoker 59 years and 4 months (101).

Raymond Pearl, one of the most outstanding statisticians of the country, located at Johns Hopkins University, studied thousands of personal records of people who were deceased (83). Below is a graphic picture of the findings:
Survivorship of White Males after Thirty Years of Age According to Smoking Habits (Pearl)

The above chart shows that the heavy smoker has hardly a 50-50 chance to live to be 53 years old, while the non-smoker may be expected to live about a dozen years longer.

As a rule, death does not occur suddenly, but is brought on by organic degeneration causing sickness and ill-health. Thus, the tendency that one who smokes heavily will enjoy life, smoking, till old age "arrives," appears very slim. As soon as the body no longer can keep up the adaptive mechanism in ridding itself of poisons, it begins
to die. The whole individual is involved — not just the pleasure senses concerned with smoking. It seems quite Hedonistic to receive pleasure at the moment, knowing that no benefit can be derived in the long run. Certainly, short-sighted and short-willed individuals are plentiful. Of course, many of these people do not know that any such truth exists. And, as in everything else, there are those that if they did know, would not care. It takes a certain amount of self discipline to remain a moderate smoker. Possessing or lacking this quality makes an individual what he is.

A few years ago, at a meeting of Carnegie Institute scientists, the study of alcohol was discussed, and it was noted that the moderate drinker lived longer than the total abstainer (Dr. Thorne Carpenter, personal letter). This seemed unexplainable. It was very evident according to one man's opinion. The man who could drink, and yet have the will power to remain very moderate was a superior type of an individual who probably exercised moderation in everything else he took part in. Thus, by all-round moderate living, he outlived the others. Although there is lack of evidence to show that the smoker will outlive the non-smoker, nevertheless, the man or woman who can willingly keep cigarette consumption down to four or five a day, stands a better chance to live moderately in all activities. It is this type of person who is more apt to have time to think, to cover more varied activities, and in substance — to be happier.
SUMMARY

All clinical and experimental data point to the far-reaching effects of tobacco smoking on the human system. These effects are usually brought on gradually, and are governed to some degree by the sensitivity of the smoker, the manner of smoking, the amount of cigarette smoked, the brand used, and the daily consumption.

Smoking deadens the desire to eat, and, if carried on heavily enough, will lower body weight through unsufficient and proper foods. Women seem most affected by this.

Thromboangiitis obliterans, the arterial disease, is aggravated and may be started by excessive smoking. The rise of the heart beat and blood pressure, due to vasoconstriction of certain parts of the circulatory system, the corresponding lowering of peripheral skin temperature, and irregular heart beats, takes place by nicotine entering the system.

Tobacco smoke is an irritant, which may or may not be due to the hydroscopic agent. Chronic irritation of the throat and larynx due to the smoking of tobacco, may give rise to hoarseness, dry cough, chronic bronchitis, tonsilitis, sore tongue, and bad breath due to the constantly healing processes. The opinion of voice teachers is that it spoils soft voices, causes "smoker's cough" and short-windedness, and dries up the membranes removing a certain amount of smoothness from the voice.
The kidneys are responsible for a great deal of the elimination of the nicotine toxin from the body. The liver may also assist the process. Bowel movement may or may not be stimulated.

The use of tobacco causes hyperacidity in the stomach which is probably due to the deadening of certain inhibiting nerve fibers which are balanced by certain accelerating fibers, so that the latter are without proper check. This may give rise to ulcers of the stomach or duo denum. Heart burn, chronic intestinal catarrh, and increased intestinal movements, are often present in the smoker.

The fact that cancer is concerned fundamentally with irritation, brings the smoking problem closer. It seems that the contributing cause of cancer is split between ragged dirty teeth, and tobacco smoking. It is suggested that families disposed to cancer, and persons with chronic catarrh give up smoking.

Nicotine does not permanently stain the teeth if they are cleaned more often. It may have some effect upon the sex glands, and ductless glands, allowing a tendency to skin wrinkles.

Both types of nerve fibres to the pupils may be affected by the action of nicotine. Visual acuity is lessened by smoking. Disturbances of the nervous system, such as excessive salivation and sweating, brachycardia, vertigo, headaches, and insomnia are numerous. The woman seems more highly sensitive than the man and reacts more to these disturbances, especially that of sleep. Smoking is a learned activity that effects the nervous system in such a way that it takes more smoking to satisfy desire as time goes on. Cigarette consumption in the individual will continue to increase without self-discipline in keeping it down.
Toxic amblyopia may be caused by vasoconstriction of the eye blood vessels or nerve inhibition, but in either case, visual accommodation is lessened. It is indicated that smoking while studying is not a help; it is a handicap. Toxic deafness may accompany toxic amblyopia from the use of tobacco.

Non-smokers are superior in scholarship than smokers. Whether the former take less time to study and more time to smoke, or whether it is due to a lessened ability to receive stimuli, is not certain. Because it takes fine muscles to think and nicotine affects these, it seems that abandonment of smoking would rise potential mental efficiency.

A contributing cause to the birth rate drop is raising sterility. Due to the physiological action of nicotine, tar, or some other substance on the ovaries and reproductive organs, it seems that fertility is lessened.

There is a tendency for mothers who smoke to lactate less milk which contains, in some cases, nicotine. There is also a tendency for serious menstrual disorders, and more than the usual number of cases of diseased sex organs. Smoking and inhaling a package of cigarettes a day is, in all probability, harmful to maternal health.

The possibility of the non-smoker living many more years than the smoker is quite probable. Physiological disturbances are often cumulative and wearing, and do not show themselves until they are beyond control. It is because of this particular diseased organ, and at this time, that the individual dies. Indirectly, therefore, the excessive cigarette smoking man or woman is preparing a pathway to a shortened life than the
non-smoker. Moderation, that is, four or five cigarettes a day, is suggested next to complete refrainment.
PART TWO
INTRODUCTION TO EXPERIMENT

The writer of this thesis has been inquisitive and puzzled from time to time regarding the truth, or lack of truth, in the ability of the cigarette to give to the smoker a "lift", so often attributed to it. Certainly, any food that gives a "lift" or improved feeling of physical condition is to be desired. In fact, it should be on hand at all times to elevate the person when he or she is tired and has much work to do. But, is tobacco a nutritive material taken into the body for the purpose of growth, repair, and maintenance of the vital processes? The answer is obvious. Tobacco is not a food. Because it contains nicotine as an agent, which introduced into the animal organism may produce a morbid, noxious, or deadly effect, it is defined as a poison. If a food builds up an organism, and a poison undermines it, how can smoking a cigarette be beneficial?

Evidence from various experimentors (Part One) indicates that smoking is not beneficial, but advertisers of tobacco with personal statements from successful men and women in every status of life, seem to suggest that smoking is a relief for the fatigued individual.

The problem, therefore, becomes evident, and is stated precisely. What indication is there that tobacco smoking physiologically elevates the smoker?
DESCRIPTION OF MEASUREMENT

In order to measure an individuals ability to get a stimulation or a depression from tobacco smoking, it becomes necessary to introduce certain constants, that is, some condition that retains the same value provided the other conditions remain unchanged. The rate of fatigue in an individual is such a constant. It will vary according to the individuals physical condition. If all conditions are kept the same in two different tests, it follows that the amount of fatigue should be the same. If, however, one definite condition is altered, and differs from the standard conditions, then the effect of that particular condition will be noted.

A measure of fatigue is a measure of strength. To ascertain the change in physical condition due to fatigue, the flexor muscles of the hand and forearm (which are directly responsible for grip strength) were measured by means of a hand dynamometer. This hand dynamometer is a small, very reliable, calibrated instrument that measures actual poundage. It fits comfortably into the hand. By concentrating all of the available grip strength into squeezing this device, a poundage score between 0 and 200 may be registered. Hence, by this strictly objective measure, grip strength is recorded as of any particular period in the life of the individual.
EXPERIMENTAL CONTENT AND PROCEDURE

In this experiment, fifteen young men between the ages of twenty and twenty-five, were measured under the same operating conditions. They were all smokers of cigarettes; some also smoked cigars, and others pipes. They varied in their amount of indulgence per day, from occasional to heavy smoking. The important item here, is that they all knew how to smoke, and were not upset, as would be the case with the novice. A description of a typical experiment follows:

The subject to be tested was ushered into a private office so that distracting stimuli were as far as possible eliminated. One hand is usually more skilled than the other. The unskilled hand (being less developed throughout the forearm and probably a better measure of change in physical condition) was used. The hand dynamometer was placed in the subject's hand. The individual squeezed this instrument with all his strength of grip. Only individuals who were friends of the writer were used, for they could be relied upon to exert their maximum effort each time they gripped. Two grip strength trials were given before the test to determine the beginning grip or starting point; that is, the best grip before the fatigue process began.

With the time checked carefully, and the record card covered from the subject's view, the grip strength was taken consecutively every ten seconds for six minutes. At no time was the subject allowed to know his score. This process of maximum gripping for 36 times (six minutes)
was naturally fatiguing. The score dropped gradually, as expected. At the end of six minutes the subject sat down and rested, smoking his own brand of cigarette for three minutes in a perfectly normal manner. He talked pleasantly with the writer during this time, that he might be completely at ease and unexcited. At the end of the three minutes he continued as before, squeezing the hand dynamometer every ten seconds for four more minutes. After taking these 24 grips (four minutes) he sat down and rested for five minutes. During this lapse of time he recovered a certain amount of strength, as of the original score. At the end of the five minutes his final grip was taken to note the recovery.

Because individuals are apt to vary slightly in their power to concentrate their effort, the six scores for each minute must be averaged, giving a mean figure per minute for six minutes. The same is done for the four minute period following the three minute rest (see Grip Record Chart p.68). A characteristic curve, starts with the subject’s best grip, drops through six minutes of testing, recovers some after a three minute time lapse of resting and smoking; then it drops through four minutes of gripping, and thenceforth recovers some after five minutes of rest. With such a curve it is possible to figure the percentage drop from the best grip to the grip at the end of six fatiguing minutes. After the three minute rest the fatigue drop percentage is naturally not as great. This difference in percent drop represents a certain per cent recovery over the six minute period (both drops and recoveries are noted on the graphs). The next four
minutes of gripping results in a per cent drop before the five minute rest period, as of the original score. After a five minute rest, the drop is, naturally, much smaller, and represents a certain per cent recovery back to the beginning score. This pictures the curve in which smoking takes place along with the rest. Whether these recoveries are due to rest alone, or to smoking and rest would not be determinable without giving another test in which smoking was eliminated.

It is acknowledged that physical condition varies all of the time. Therefore, the probability of getting a subject in the same physical condition for a second test is practically impossible. (That is why percentages within the individual curves are used). The individuals in this experiment were given the second test a few days later at about the same time of day. The room, the atmosphere, and the experimental procedures were kept exactly the same as in the previous test. The only difference in the second test was that no cigarette was smoked during the three minute rest period. Everything else was the same as described above. In this way it was possible to set up a situation in which the recovery after six minutes was due entirely to rest, whereas, in the first test it was due to both smoking and rest. Also, in the first test the recovery after five minutes was due to rest with lingering smoke effects, and in the second test to rest only. Thus, by a comparison of the per cent recovery of the first test (due to smoking and rest) and a per cent recovery of the second test (due to rest only), it is quite possible to tell whether an individual receives more of a stimulation from the cigarette and rest, than from the rest alone.
In other words, if a per cent recovery was obtained after three minute time lapse due to smoking and rest that was higher than that of rest only, the subject would have received a stimulation or "lift" from the cigarette. Likewise, if the final recovery (after five minutes) was greater in the rest only curve than in the smoke and rest curve, the individual would have been depressed due to smoking the cigarette.

The Grip Record Chart shows the results as calculated; the graphs illustrate them, more clearly.
## GRIP RECORD CHART

Mean of Six Trials Per Minute

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RISE AND FALL OF GRIP STRENGTH DUE TO SMOKING AND REST

SUBJECT: C. H. (M)  AGE: 22  WEIGHT: 152

% RECOVERY (all of original score) AFTER SMOKE AND REST 3 MINUTES = 42%

REST ONLY  = 29%

% RECOVERY (all of original score) AFTER 5 MINUTES REST—SMOKE CURVE = 87%

REST CURVE = 83%
DISCUSSION OF RESULTS

In reading the individual graphs, care must be taken not to compare parts of one curve structure with that of the other. The curve must be studied as a unit. It is misleading to notice the sharper incline (in some curves) of the three minute time lapse line in the rest only curve, and conclude that a larger stimulation has taken place. An example of this is found on the graph of subject R.G., who had a 90 per cent recovery after rest only, and only 67 per cent after smoking and rest, yet, with the two curves together it looks as if he had a recovery due to smoking and rest. This same subject had a great depression due to smoking, yet the inclination of the five minute time lapse line is only slightly greater than the rest only line. This shows the fallacy of reading irregular curves against the other. If the graphs were as close together as the mean graph, this would be somewhat different. Depressions will generally show up by a sharper incline of the rest only line (five minute time lapse line) but slight depressions are apt to look incorrect in this manner. Therefore, the only true way to read the curves is to remember that it is the per cent recovery within the individual curve that is significant for comparison of one curve against the other.

The mean graph of the fifteen individual graphs shows the trend of these subjects. It is included to show that smoking may or may not be an immediate stimulant, but, in the end is a definite depressant. It is wrong to conclude that it is always a stimulant. Reading the individual
graphs is far more significant in showing actual truths than reading the mean graph. The latter shows only the general trend.

There is a great deal of work yet to be done before it will be known why smoking stimulates some people and does not do the same for others. It is known, however, that there is an elevation of blood sugars when smoking takes place (29,65,36).

Johnson, from the research department of the New York Life Extension Institute, noticed this sugar rise over a year ago (94). It is believed that nicotine stimulates the adrenal medulla through the sympathetic nervous system, thus increasing the output of adrenalin. Sollmon attributes the rise of blood pressure to the addition of adrenalin to the system. This output is briefly increased, but is followed by a marked and enduring decrease (98). As far back as 1912, animal experimentors discovered that nicotine injections produced adrenalin which was later followed by a diminished secretion (26). In 1935 Houssay and Molinelli noticed temporary blood sugar increases due to adrenalin (53). Three years later Caponetto reported hyperglycemia, and Burstein and Goldenberg the same (16,11). Lundberg and Lundberg in 1931, after extensive experimentation, found that the action of nicotine on the sympathetic nervous system and the adrenal glands, released part of the glycogen stored in the liver and muscles, causing temporary hyperglycemia (67). Three years later Haggard and Greenberg reported a rise in blood sugars with a corresponding rise in the respiratory quotient (45). With adrenalin discharged acting to release glycogen in the liver and muscles, the blood sugars rise, which necessitates a rise in carbohydrate
combustion, thus the need for more oxygen causing the respiration to increase.

Kowing some of the above facts, the tobacco manufacturers have hastened their conclusions regarding the stimulating effect of tobacco smoking. Realizing that many people look only to the immediate results, and no further than this, they deluge the press and air with claims of "energizing effects", "scientific ratification", "increased energy", "gives you a lift", "relieves fatigue", etc. It has been wisely uttered that one of the most important lessons of experience is learning to distinguish between the facts of observation and the inferences drawn from these facts. Admitting that nicotine does give rise to more sugar in the blood, so does morphine, strychnine, chloral hydrate, ether, chloroform, carbon monoxide, cocaine, bichloride of mercury, and the following infectious diseases such as cancer, hemorrahages, ordinary burns, typhoid fever, influenza, asphyxia, syphilis, tuberculosis, and diphtheria (70). But of these, there is none that is regarded as being energizing to the human organism.

Walter B. Cannon of Harvard University, tells of another sugar response connected with emotional disturbances of fear, pain, and rage. In these instances sugars are raised that a display of muscular energy may be involved (15). When a person smokes it appears to be a different situation. Circulation must be increased for hasty removal of toxic substances. Sugar is thrown into the system increasing respiration and likewise increasing circulation. Bodily exertion in this case would seem to throw an extra load on the detoxication mechanism. Such an
extra load would seem to explain the lessened ability to recover from fatigue, as found in the smoking and rest experiments. McCormick, a Canadian says (70), "...the glycerine response to nicotine absorption in tobacco smoking is a protective reaction of the organism, which, while being adapted to minimize the toxic effects, decreases potential muscular energy by dissipating the bodily reserves of glycogen...Thus the 'lift' attributed to the cigarette is in reality a handicap which nature tries her best to counteract."

Despite what the tobacco people know about the rise in blood sugars, the experiments conducted by the writer show that some people get a "lift" from smoking while others get more of a "lift" by rest alone. Perhaps an individual's daily physical activity, and the number of cigarettes smoked during the day has something to do with this. More experiments of this nature will have to be conducted to solve this problem.

The main point of significance, that is so well brought out in these individual experiments, is that smoking is a depressing activity. It is nothing new to say that drugs are depressants, but it has to be shown that the nicotine in the cigarette has the same devitalizing influence, before the average person will be concerned.

It was Mendenhall that noticed brain depressions due to smoking (Part One, p. 41), and the studies of Couch showed that smoking may be first a stimulant and later a depressant (Part One, p 38). Subjective, personal feelings are not too far from being correct, for it has already been mentioned (Part One, p. 34) that the majority of the Wellesley
College smokers felt that cigarette smoking did not give them a "lift", but only soothed their nerves. Whatever sugar rise there may be in some individuals to elevate their physiological consciousness, seems to be overcome by the action of nicotine on the nervous system. This experiment seems to indicate that any rise is soon lost, with a further depression resulting. Certainly a 22 per cent depression (on the mean graph) as shown in these experiments is significant to an individual's capacity for efficient activity.

Perhaps the Chinese philosopher, Lin Yutang, is not far from being correct when he feels relaxed with his smoking pipe, is emotionally set in a quiet state, and ready for a congenial philosophical discussion (121). This may be of value to the person with high physical fitness who finds it difficult to remain quiet very long. If the action of nicotine is finally to depress the individual, he will likely relax and become less aggressive. Of course it is not so much the desire of wanting to be more at rest, as it is the physiological impossibility of being otherwise. Thus relaxed, with less tension, there is probably manifestation to recuperation from fatigue, despite the extra energy spent at the beginning of the smoke. The pleasing feeling in manipulating the cigarette or pipe from the pocket through to the ash tray also bears attention. This is an activity that has been learned, habitualized, and has become quite pleasurable.

This induced form of rest and satisfaction, however, can be received in a more positive way by stronger drugs than nicotine. Since the nervous system is affected, reaction cannot be as quick to stimuli.
Thus when Yutang takes time to think by picking up his pipe, he does so more or less by necessity, and not entirely to any atmosphere developed by smoking. Hence, pleasurable satisfied, physically relaxed, muscallylly weaker, and sense-blunted, the individual is somewhat inactivated. That mental efficiency is better in this setting seems doubtful. In fact, the ability to perform any activity, must be proportionately decreased. Therefore, the individual who smokes before starting to study, or previous to any physical tasks (sports or labor), or before any activity, cannot be expected to perform to his fullest extent.
CONCLUSIONS WITH SUGGESTIONS FOR FURTHER STUDY

Various experimentors have noted a rise in blood sugars due to the nicotine in tobacco smoke. This was probably due to the stimulation of the adrenal medulla through the sympathetic nervous system.

The results of the fifteen experiments show that some individuals get a stimulation immediately following smoking, while others get more of a stimulation from rest alone. The results show 100 per cent that the end product of smoking, whether it stimulates or not, is to depress the subject. Whatever sugar rise there may be in some individuals to give them a "lift", seems to be shortly overcome by the action of nicotine on the nervous system. This depression was noticed by lingering grip strength, and lessened ability of the individual to recover from fatigue.

It can be concluded in general, that nicotine containing substances are depressants to the human organism. Hence, activity cannot be carried on to its greatest extent or exactness, when the organism is below normal, that is, depressed.

From an experiment of this type, many questions arise for further consideration and experimentation. For instance, the fact that individuals do not recover from fatigue after smoking as quick as they do without smoking, raises a question. Are there more fatigue products in the muscles; is there a slower passing of these products from the muscles, or does nicotine effect the nerves going to them so that the
height of contraction is lessened?

There are many more questions unanswered. How would smoking a cigar effect these curves? Would smoking one-half a cigarette be different than a whole? How large a part does inhaling play in stimulating and depressing an individual, or is it the same as not inhaling? Do heavy smokers receive more of a depression than moderate or occasional smokers? Do individuals who get a "lift" sustain it longer if they are light smokers, and do they show less depression?

Does the amount of outdoor activity during the day govern the depressing effect of nicotine on the organism? In other words, does a highly active individual, who smokes moderately, stand a chance of being depressed less in this experiment than another moderate smoker who is less active during the day? It would seem that an individual's normal activity might have much to do with his ability to recover, since trained individuals recover from fatigue quicker than the untrained. A better functioning physiological system removes fatigue products quicker than one not so conditioned.

How would the above questions be answered with women instead of men? How would different age groups compare? What is the effect on adolescents who smoke? How would men and women non-smokers react to smoking in this experiment? What would be the effect if several women smokers were tested and then gave up cigarettes completely for a week, to be retested at the end of this period?

How would the rise and fall of blood pressure after smoking compare in this experiment if taken after the three minute rest period, and
again at the end? So little is known about the action of the human body, that the surface has only been touched as far as questioning goes. By answering these questions, people may be more intelligent about their daily habits and reasonably happier in a somewhat longer life.
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